

intestine; and cicatrized ulceration is, perhaps, the commonest cause of stricture. In this locality stricture from any cause is asserted by Dr. Hilton Fagge, in his excellent study of intestinal obstructions,¹ to be very rare; and if we admit the syphilitic character of the ulceration in this case, it will be, as far as I can learn, unique. It is noticeable that, even if the progress of the diathetic disease had been ultimately controlled by treatment, the tightness of the stricture of the ileum might at any time have caused fatal obstruction by lodgment of ingesta.

Again, there is evidence recently placed on record by Fournier, Trélat, and Malassez, that tertiary syphilitic infiltration about the rectum and anus may give rise to stricture in this locality. The present case tends to confirm this evidence, and to establish the fact of stricture from true syphilis. Finally, in the absence of ulceration, to which, strangely enough, this form of syphilitic infiltration does not, at least in the rectum, seem to be prone, and in the absence, consequently, of the contractile element of cicatrization, stricture from true syphilitic infiltration would seem, if this case has been correctly observed, to be curable by well-directed anti-syphilitic treatment.

ARTICLE II.

SARCOMA OF THE LONG BONES; BASED UPON A STUDY OF ONE HUNDRED AND SIXTY-FIVE CASES. By SAMUEL W. GROSS, A.M., M.D., Mütter Lecturer on Surgical Pathology in the College of Physicians of Philadelphia, and Surgeon to the Jefferson Medical College Hospital, and to the Philadelphia Hospital.

IN the number of this Journal for July, 1879, I considered the more important points in the general pathology and diagnosis of sarcoma of the long bones and completed the study of giant-celled or myeloid tumours. In the present paper I shall describe the remaining central growths along with those of periosteal origin, and compare them with the view of establishing their differential diagnosis.

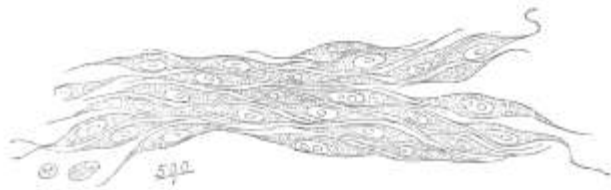
2. CENTRAL SPINDLE-CELLED SARCOMA.

Spindle-celled sarcomas, which are synonymous with the fibroplastic tumours of Lebert, the plasmomas of Follin, the fasciculated sarcomas of Cornil and Ranvier, the recurrent fibroid tumours of Paget, the fibronucleated tumours of Bennett, the albuminous sarcomas of Gluge, the fasciculated carcinomas of Müller, and, in their soft forms, with the medullary or encephaloid cancers of many authors, are next to the giant-celled tumours the most common of the myelogenic sarcomas of the long bones.

¹ Guy's Hospital Reports, vol. xiv. 1869.

The elements of which they are composed, and which have their analogues in the corpuscles of developing and newly-formed connective tissue, vary greatly in their morphology in accordance with the different stages of their development. In the fibronucleated growths they look as if they were merely naked nuclei of an elongated oval form. In the recurrent fibroid or fibroplastic tumours, they are oat- or awn-shaped, or made up of slender, delicate, elongated, nucleated spindle cells. In the typical spindle-celled sarcoma, as is shown in Fig. 1, which I drew from a section of a tumour of the head of the tibia, the cells are thick, and full, and plump, and provided with one or more large nuclei, while their bodies are drawn out at each end into a filamentous process, which is sometimes divided, and renders the cell so large that it may extend over one or two fields of the microscope. From these differences in size a distinction is made between the small spindle-celled and the large spindle-celled tumours. The dimensions of the elements, indeed, appear to exert a most decided influence upon the consistence and prognosis of the growth, since it is precisely the small-celled sarcomas that are more liable to be medullary and the more disposed to recur after extirpation and occasion metastatic deposits in the internal organs.

Fig. 1.



The cellular constituents are separated, and at the same time united, by a more or less abundant hyaline, slightly granular, or, as when the growth shows evidences of a higher degree of development, as happens in the fibrous sarcomas, fibrillated intercellular substance, and they interdigitate, that is to say, the extremity of one cell is received between two contiguous cells, so that a tissue results, which is made of bands or fasciculi of closely aggregated cells. These bands pursue a parallel course, interlace in every part of the tumour, or radiate from its centre towards the periphery so that, on section, groups of what seem to be small round cells, but which are in reality transverse cuts of fusiform elements, are seen to be surrounded by longitudinal bands of spindle-celled tissue.

Spindle-celled sarcomas are met with as smooth, or slightly nodulated, but rarely bosselated, spherical or ovoid tumours, which are limited by a capsule which is indifferently periosteal, or bony, or partly membranous and partly osseous. Their cut surfaces are generally smooth, glistening, and succulent, and of a white or grayish-white tint, even when the growth is soft and fluctuating. In many specimens the prevailing colour is rosa-

ceous. In others, the white or rosy surface is marked by yellow areas, which are denotive of fatty changes, or by dark red or brown spots, which indicate points of increased vascularity or minute extravasations of blood. Their consistence is, for the most part, firm and elastic, rarely soft, and now and then positively dense and hard; and they tear apart with a fibrous grain.

Retrograde changes and accidents are not common. In one case small softening cysts were interspersed throughout the mass; in three extravasation-cysts were present; in one the large spindle-celled tissue was separated by islets of cartilage in all degrees of development; while, in three examples, calcification, or ossification, was progressing. It is interesting to note, in connection with what I have previously stated in regard to the malignity of osteoid myeloid sarcomas, that one of these cases succumbed from local recurrence and metastatic deposits.

The vascularity of these tumours is not pronounced. In the case of Demarquay, recorded by Lebert,¹ the firm, elastic growth, which was as large as a turkey's egg, pulsed and was the seat of a blowing sound, and yet the gross appearance of the tissue bore no evidences of the inordinate development of vessels, the cut surfaces varying in colour between pale yellow and yellowish-rose. In an instance reported by Richet,² there were also pulsation and a bruit de souffle. That the bloodvessels are, however, occasionally much enlarged, and the seat of sarcomatous degeneration, if not actually the starting points of the disease, is shown by the case of Mr. Adams,³ and by the following abstract of an example of hemorrhagic chondroid spindle-celled sarcoma of the lower end of the femur, recorded by M. Urdy.⁴

CASE I.—A farmer, aged 32 years, experienced, in May, 1869, lancinating pains in the region of the knee, and, six months subsequently, perceived a small tumour on each side of the articulation. At first they grew slowly; but at the end of nearly three years, when they had united on a level with the inferior third of the femur, their volume was so large as to require the man to leave work and go about on crutches. On admission into the Hôpital de la Pitié, Feb. 13, 1872, the tumour, which was ovoid, with its large extremity below, was found to extend from four inches below Poupart's ligament to the upper part of the leg. Its largest circumference was 0.85 m. or about thirty-three inches; its consistence was soft and fluctuating, especially below and externally, or at a point which corresponded to the blood cyst, and it was the seat of a dull pain which was increased by pressure; the lymphatic glands were normal; the motions of the knee were abolished; and progression without crutches was impossible. The skin was stretched, and the subcutaneous veins were voluminous.

On the 2d of March, M. Labbé amputated the thigh about an inch and a half below the great trochanter, and death ensued from purulent infection on the eleventh day. All the muscles were inserted into the periosteal capsule of the tumour, which was irregular, bosselated, of a dull white colour, hard at some points, and soft and fluctuating at others. At the outer part was a cyst, which

¹ *Traité d'Anat. Path.*, vol. ii. p. 591, and Atlas, plate clxx. fig. 8.

² *Bull. de la Soc. de Chir.*, vol. v. ser. 2, p. 21.

³ *Trans. Path. Soc. London*, vol. v. p. 254.

⁴ *Bull. Soc. Anat. de Paris*, ser. 2, vol. xvii. pp. 132 and 180.

contained six pints of a brown chocolate-coloured fluid mixed with fibrinous clots. Its inner surface was irregular, bosselated, and lined with decolorized coagula. The femur was fractured just below the trochanter, and a button of the morbid tissue projected into the medullary canal. The tumour was a large spindle-celled sarcoma, intermixed with islets of cartilage. The articular cartilage of the femur had undergone sarcomatous degeneration, but was not perforated.

Spontaneous inflammation, ulceration, and fungous protrusion had not occurred in any of the cases that I have collated. In one, recorded by Birkett,¹ incision into the tumour was followed by the formation of a large, fungous, bleeding, and sloughing growth. Insult of this nature is not, however, necessarily attended with so untoward an event, since in the case of Bickersteth,² a free incision closed promptly and permanently. Indeed the healing process does not appear to be retarded by the presence of spindle-celled tissue, as, in the case of Birkett, the tibia, which was broken at the site of the tumour, was completely consolidated in six weeks.

Central spindle-celled tumours are far more common in the shafts of the long bones than are myeloid sarcomas, that locality having been occupied once in every three and three-fourth cases by the former, and only once in every seventeen and one-half cases by the latter.

Their seat in 16 examples was in the

Tibia, upper epiphysis,	in 2 cases,	shaft, in 2 cases.
Femur, lower	" " 5 "	" " 1 "
Fibula, "	" " 1 "	
Ulna, upper	" " 1 "	
Humerus, upper	" " 2 "	shaft in 1 case.
Humerus, seat unknown	" 1 "	

Eleven cases occurred in males and five in females, and four were traceable to traumatism.

The age at which they were first noticed was, respectively, 10, 19, 20, 21, 24, 29, 31, 32, 34, 38, 41, 41, 51, 56, 61, and 68 years, the average being 36 years. Hence they are not so frequent before the thirtieth year by 29 per cent as are the giant-celled sarcomas.

The growth of spindle-celled tumours is, on the whole, not so rapid as that of myeloid sarcomas, although in some cases they increase very quickly, and attain, for example, a circumference of nineteen inches in one year,³ or of thirty-three inches in thirty-four months.⁴ These were instances of hemorrhagic sarcoma. As an illustration of slow growth, the case recorded by Dr. Green⁵ may be mentioned, in which the tumour acquired the size of an orange in two years, and was composed of moderately firm pure spindle-celled tissue. The rate of increase and volume appear, therefore, to depend upon the consistence and integrity of the tissue; the

¹ Guy's Hosp. Reports, ser. 3, vol. x. p. 159.

² Trans. Path. Soc., London, vol. xvi. p. 227.

³ Horteloup, Bull. et Mém. de la Soc. de Chir. de Paris, vol. ii. p. 676.

⁴ Urdy, ante.

⁵ Trans. Path. Soc., London, vol. xx. p. 277.

firmer variety being marked by chronicity and moderate dimensions, while the soft, medullary, or encephaloid variety increases quite rapidly, and is far more bulky, particularly if it be the seat of extravasations of blood.

Spindle-celled sarcomas evince little disposition to break through their investing capsules. Hence the associated and surrounding tissues are rarely the seat of local infection, while metastatic deposits, as will be shown presently, occurred in only three instances. The medulla of the shaft above the seat of the tumour was invaded in one case,¹ while in one example² the cells of the articular cartilage were undergoing sarcomatous proliferation, but the joint itself was intact. In the instance recorded by Volkmann,³ the cartilage of the head of the humerus had undergone sarcomatous degeneration, and was the seat of sieve-like perforations. In the case of Horteloup,⁴ the enormous tumour of the olecranon process had projected masses into the elbow-joint, and dislocated the head of the radius forwards; and in the case of Grohe,⁵ the joint was invaded. In not a single instance were the associated lymphatic glands involved, either as the result of irritation or invasion by the disease. Hence the contrast in this respect between spindle-celled and giant-celled sarcomas is most striking.

The malignity of spindle-celled sarcoma is demonstrated by the following cases, which represent 23.07 per cent. of the whole number:—

CASE II.⁶—A girl, aged 10 years, underwent amputation at the shoulder-joint on account of a medullary sarcoma of the humerus, which was made up of fibro-nucleated tissue, and contained thin plates of bone. “The wound healed readily; but three months afterwards the disease returned in the cicatrix, which presented a tumour the size of a pigeon’s egg. Thirteen days after, a soft bulky tumour appeared in the occiput, which increased until her death, two months afterwards. On dissection, medullary tumours were found surrounding the glenoid cavity, attached to the occipital bone externally, and causing caries of it, and also between that bone and the dura mater.”

CASE III.⁷—A woman, aged 51 years, had suffered for eleven years from intermittent pains, which were aggravated by cold, at the outer part of the ankle. In April, 1867, she first noticed a swelling about three inches above the lower extremity of the fibula, which afterwards enlarged rapidly, and was attended with much pain. On the 25th of November, 1867, the lower four inches of the fibula were found to be involved by a smooth tumour, which was principally solid and elastic, but fluctuated at one point, and was tender on handling. The skin was tightly stretched and adherent over the mass; and at the most prominent point the cuticle was peeling, and the cutaneous capillaries were enlarged and tortuous.

The leg was amputated on December 3, or eight months after the growth was first noticed; but death ensued from pyæmia on the twelfth day. Two patches of “medullary cancer” were found in the upper lobe of one of the lungs; but as the primary growth “microscopically and to the naked eye displayed all the features of fibroplastic tumours,” there can be no doubt that the secondary deposits were of the same nature.

CASE IV.⁸—A tailor, aged 36 years, consulted Professor Grohe on account of

¹ Urdy, ante.

² Langenbeck’s Archiv., vol. xv. p. 563.

³ Bardeleben, *Lehrb. der Chir. und Operationslehre*, 6th ed., vol. i, pp. 566 and 576.

⁴ Bennett, *On Cancerous and Cancroid Growths*, p. 108. Edinburgh, 1849.

⁵ Bryant, *Trans. Path. Soc., London*, vol. xix. p. 317.

⁶ Urdy, ante.

⁷ Ante.

⁸ Grohe, ante.

a tumour of the lower end of the femur, of five years' duration. It was thought to be a malignant formation, although the skin and the inguinal glands were normal. Amputation was out of the question in consequence of lung complications, from which death ensued shortly afterwards. On section, the condyles of the femur were found to be replaced by a soft small spindle-celled sarcoma, which had extended into the knee-joint and the ham. Both lungs were the seat of metastatic growths, as large as the fist, and the bronchial glands were converted into a sarcomatous mass as large as a hen's egg.

Of the sixteen cases here analyzed, one¹ died of pneumonia without operation, the tumour, which was of two years' standing, and only four inches in circumference, having occurred in a man sixty-eight years of age. In the case of Grohe, death ensued in five years from general infection, without surgical aid. Of the remaining fourteen, thirteen underwent amputation, and one excision. In three of these there is no further history.² Of the other eleven, six died from the effects of the operation,³ and in one there were metastatic deposits; one remained well for seven years, which was the date of the last report;⁴ one was alive at the end of seven months;⁵ one was doing well at the expiration of five months and a half;⁶ one recovered from the operation, but died in five months from local and general infection;⁷ and one was alive two weeks after amputation.⁸

The total duration of life from the first appearance of the disease until its termination after surgical interference, varied from five months to eight years, the average having been 37.2 months, which is three months less than the mean duration of life in giant-celled sarcoma. None of the cases, however, came under treatment as early as did the cases of the latter variety of tumour.

Central spindle-celled sarcomas usually declare themselves by spontaneous pain, that symptom having been the earliest manifestation of the affection in 60 per cent. of all instances. Attention was first directed to them by a tumour alone in 30 per cent. of the cases, and by simultaneous pain and tumefaction in 10 per cent. Pain appears to be uniformly present at some period. In its nature it is usually continuous and severe, and of a rheumatoid or gnawing nature; it is occasionally worse at night, and is aggravated by exercise and handling.

The skin is variously altered in 40 per cent. of all cases, being of a violaceous or purplish tint, tense and thinned, and adherent in about equal proportions.

The subcutaneous veins are enlarged in one half of all cases. Lymphatic involvement is never observed.

Spontaneous fracture, or fracture from very trifling causes, of the affected

¹ Coyne, *Bull. de la Soc. Anat.*, vol. xiv. ser. 2, p. 106.

² Cases of Horteloup, Demarquay, and Adams.

³ Cases of Urdy, Green, Bryant, Birkett, Kelly (*Trans. Path. Soc.*, London, vol. xx. p. 266), and Volkmann.

⁴ Birkett, *Guy's Hosp. Reports*, ser. 3, vol. x. p. 168.

⁵ Reference mislaid.

⁷ Case of Bennett.

⁶ Case of Bickersteth.

⁸ Case of Richet.

bone is met with in 44 per cent. of all cases, and is a symptom of value when considered in connection with other phenomena. Thus, if after the patient has experienced pain at a localized point for some months, the bone breaks, and a swelling develops more or less rapidly, the probabilities are greatly in favour of a sarcomatous tumour; but the particular variety of tumour will have to be determined by other symptoms, since this course of events occurs in the round-celled, as well as in the spindle-celled sarcomas.

The tumour itself has a globular or ovoid outline; its surface is generally even; its consistence is, for the most part, firm and elastic, with, possibly, one or more points of fluctuation. When its limiting capsule is bony, as happens in one-third of the cases, it may be densely hard; or, in the event of the cyst being very thin, or partly membranous, parchment-like crepitation may be elicited. On exploratory puncture, the trocar will be found to be fixed, or not move freely, and only a little blood will escape by the canula. In the hemorrhagic form of the disease, however, these signs will be reversed. Pulsation and other signs of aneurism are met with in only $12\frac{1}{2}$ per cent. of all cases.

From these considerations it follows that a moderately large, painful, rather rapidly growing, fixed, globular, firm-elastic, smooth, non-pulsatile tumour, seated in the shaft or epiphysis of a long bone, which is probably fractured, at about the thirty-sixth year, associated, possibly, with discoloration of the skin, and with enlargement of the subcutaneous veins, but with absence of lymphatic involvement and deterioration of the general health, may be pronounced to be a central spindle-celled sarcoma.

The treatment of this class of tumours should be conducted upon the same general principles as those which govern the management of myeloid sarcomas.

3. CENTRAL ROUND-CELLED SARCOMA.

Of all the neoplasms of the bones, there is none about which so much confusion exists as those termed round-celled sarcomas by Virchow, embryoplastic tumours by Lebert, medulla-celled tumours by Robin and Nélaton, granulation sarcomas by Billroth, and encephaloid sarcomas by Cornil and Ranvier. Foerster included them among the juiceless carcinomas, and they were formerly regarded as encephaloid cancers. Even at the present day, they are described under the head of medullary cancer by Paget, Holmes, and others, the prefix medullary indicating that they possess the consistence and colour of the white substance of the brain.

The structure of this variety of sarcoma is usually very simple, consisting, as it does, mainly of spherical fragile cells, provided with a round or oval nucleus, and of the dimensions of the lymph or colourless blood-corpuscles, and contained in a homogeneous, dimly granular, or finely fibrillated matrix. In a word, round-celled sarcomatous tissue is made up of delicate capillary vessels, which are, however, less abundant than in

ordinary granulations, the spaces between which are filled by small, round, lymphoid cells, held together by a scanty, soft, amorphous intercellular substance. Hence their likeness to granulation tissue and to the medulla of embryonic bones, on which account the terms granulation sarcoma and medulla-celled tumour have been applied to them.

From these general features there are some histological variations. Thus in a tumour of the head of the tibia, I found that the intercellular substance formed a delicate reticulum of pale, transparent fibres, the meshes of which were occupied by a single round or ovoid cell, of an average diameter of $\frac{1}{2300}$ of an inch, and containing a nucleus, the mean diameter of which was about two-thirds of that of the cell. When entirely freed from the corpuscular elements, the hyaline fibres, at many spots, appeared to proceed from a common centre, or nodal point, as is delineated at *a*, Fig. 2, which I drew from a partially pencilled-out section. The entire structure, therefore, was very similar to the cytogenous or adenoid tissue of the lymphatic follicles. This variety of round-celled sarcoma corresponds to the glious sarcoma of Virchow,¹ and is described by Rindfleisch² as lymphatic gland-like, or lymphadenoid round-celled sarcoma.

A still greater departure from the ordinary type of tissue, and it was met with in four of the cases which I have collected, is observed in the tumours originally classed by Billroth³ as alveolar sarcoma, an illustration of the minute appearances of which is afforded by Fig. 3, copied from that

FIG. 2.

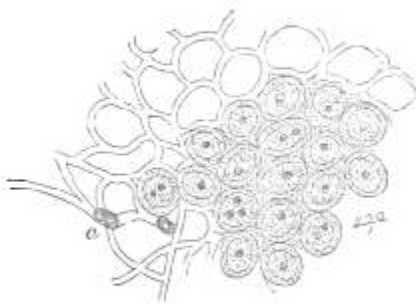


FIG. 3.

¹ Op. cit. p. 208.² Op. cit. 134.³ Langenbeck's Archiv, vol. xi. p. 224.

observer. Roundish heaps of small cells, which look not unlike giant cells, are seen to be contained in the alveoli or spaces of a connective-tissue meshwork. At certain points the masses of cells are intersected by delicate bands of connective tissue, which are given off by the coarser trabeculæ, and which divide the larger clusters into smaller ones. The formation of these fine fibrils is ascribed by Billroth to the condensation of the outer layer of the protoplasm of the cells, in which view he is upheld by Neumann.¹ Tumours which possess this structure are excessively vascular. In the case from which the illustration was taken,² it occupied the shaft of the tibia of a man, aged 29 years, was of two years' duration, and was characterized by marked pulsation, and a bellows sound. The telangiectatic tissue was found, after amputation, to be the seat of numerous extravasations of blood. The enormous production of new vessels has, therefore, led Dr. Jaffé³ to regard alveolar round-celled sarcomas as being nothing more than plexiform angiosarcomas, the alveolation being due to the course pursued by the numerous vessels. He, moreover, traces the production of the sarcomatous elements to the proliferation of the nuclei of the vessels, and quotes numerous authorities who recognize this mode of genesis of sarcomatous tumours in various parts of the body. His deductions are based upon the study of a pulsating periosteal alveolar sarcoma of the iliac bone; and it is a striking fact that nearly all of the recorded growths of this nature, whether central or peripheral, were the seat of pulsation, and were often confounded with aneurism.

It will thus be perceived that the formation of an alveolar stroma in certain sarcomas of the bones is referred by Billroth to changes which take place in the cells, while Jaffé refers it to the course pursued by the bloodvessels of the neoplasm. That the latter do play an important part in the production of an alveolar structure there can be no doubt, and I am myself disposed to agree with Jaffé that the walls of the alveoli in the very vascular sarcomas are formed by the capillaries, and, with Weber,⁴ that in the less vascular tumours the stroma is due to the obliteration of these channels and their conversion into solid fibres.

I have myself quite recently had the opportunity of studying this variety of morbid growth, for the specimen and the history of which I am indebted to Dr. T. H. Burchard, of New York.

CASE V.—A married woman, in excellent general health, and 24 years of age, came to the New York Dispensary, Oct. 18, 1875, on account of a very painful tumour of the right knee, which measured thirteen inches more in its greatest circumference than its fellow. There was no discoloration of the skin; a few large veins crossed the growth; and the inguinal glands were not involved.

¹ *Prager Vierteljahrschrift*, vol. ii. 1871, p. 6.

² Billroth, *Chirurgische Klinik*, Zurich, 1860-67, p. 568.

³ *Langenbeck's Archiv*, vol. xvii. p. 102.

⁴ *Virchow's Archiv*, vol. xxviii. p. 237.

Two years previously, without assignable cause, she was seized with intense pain in the knee, which soon began to swell. It was then treated as synovitis, and a plaster-of-Paris splint, which was applied, intensified her suffering to such a degree that it had to be removed. In September, 1874, or eleven months after the trouble was first noticed, Professor Post tied the femoral artery, under the supposition that he was dealing with an aneurism of the lower end of the femur. The operation materially relieved the pain for some months. In April, 1875, the tumor was diagnosed to be cancerous, but she declined surgical interference. When seen by Dr. Burchard, it was pronounced to be an osteosarcoma, and amputation was advised.

After this date, the woman was lost sight of, until January 24, 1876, when she was found to be excessively emaciated, suffering greatly from dyspnoea, and in a dying condition. The total duration of the disease was two years and three months. A complete autopsy was not permitted.

On laying open the osteo-periosteal capsule, I found that the growth originated in the lower epiphysis of the femur, which was separated from the shaft by a dentated fracture. It was a medullary tumour, and the seat of large extravasation-cysts, and extensive calcareous deposits. The investing cartilages of the joint were sound.

Minute examinations, which were conducted with Dr. Shakespeare, of thin sections taken from the firmer, fibrous-looking, peripheral portions of the neoplasm, disclosed a connective tissue stroma, the trabeculae of which inclosed round, oval, and fusiform alveoli, which averaged $\frac{1}{300}$ inch in length and $\frac{1}{1000}$ inch in breadth, and were filled with lymphoid cells, containing large nuclei. Although the vessels were not injected, they were seen to have undergone sarcomatous changes.

It will thus be seen that the likeness of alveolar round-celled sarcoma to encephaloid or soft carcinoma is so great that a mistake is liable to occur to an inexperienced observer. Indeed, these tumours are regarded by Rindfleisch¹ as sarcomas undergoing carcinomatous degeneration, on which account he terms them carcinomatous sarcomas. The points of distinction, however, are, first, that the cells are intimately connected with the walls of the alveoli or the vessels which form the alveoli; secondly, that, by pencilling, an intercellular substance, like that met with in the lymphadenoid form of tumour, is disclosed, the fibres of which arise from the coarser trabeculae which separate the tissue into groups of cells, and, thirdly, that the cells are pretty uniform in shape and size, being round and oval, and of about the dimensions of a white blood corpuscle. In carcinoma, the cells are of an epithelial type, loosely heaped in the loculi, without the intervention of intercellular substance, and polymorphous, and vary greatly in size. In other words, in alveolar sarcoma the stroma and cells are intimately interwoven into a single tissue, whereas in carcinoma, the cells and stroma are easily separable into two distinct tissues.²

Like the other forms of central sarcoma, round-celled tumours are generally globular or ovoid, and of a smooth, even outline. When, however, they are very soft, or are the seat of extravasations of blood, or when they

¹ Op. cit. p. 136.

² Vide Waldeyer, Virchow's Archiv, Vol. lv. p. 151.

have burst through their capsules, they are bosselated, and in this event the prognosis is bad. They are contained in an investing capsule, which is usually membranous or partly osseous, and completely bony in one-fourth of all instances. From the inner surface of the capsule bands are sometimes given off which intersect the mass and give it a lobed appearance.

On section, the cut surfaces are white, grayish-white, pinkish-yellow, or rosaceous gray, and pervaded by enlarged vessels, or marked by dark-red, or brown, or violaceous points, or dotted with minute ecchymoses. In some examples, the tissue looks precisely like a recent coagulum; in others, and this is not infrequent, the centre of the tumour is occupied by a single cyst filled with blood in various stages of transformation, or by numerous extravasation-cysts. In other specimens yellow areas denote fatty changes. Their consistence is usually soft and moderately elastic, but they are so friable that they are readily crushed by slight pressure. In some examples there is a disposition on the part of the material to tear in bundles; but, in general, their consistence, when they first come under observation, at which time they have undergone certain retrograde changes, is comparable to that of softened cerebral pulp.

The vascularity of round-celled sarcomas is varied. In the tumours which are composed of a tissue analogous to that of granulations, the blood supply is comparatively slight. In the lymphadenoid and alveolar forms, on the other hand, the tissue is pervaded by voluminous vessels, arterial, venous, and capillary. Hence it is by no means uncommon, when the arteries predominate, for these tumours to pulsate and simulate aneurism, as happened in the cases of Billroth,¹ Burchard,² Mercier,³ and Lücke.⁴ In other, or in the same, instances, extensive interstitial effusions of blood are met with, as occurred in those recorded by Bryant,⁵ Poland,⁶ Lücke,⁷ Weil,⁸ Burchard,⁹ and Butler,¹⁰ through which the neoplasm has the appearance of a recent clot, or is converted almost entirely into a large blood-cyst, the walls of which are composed of a thin layer of the original sarcomatous tissue, and, perhaps, lined by soft clots or layers of fibrine. From these accidental appearances have originated the names hæmatoma of bone, hæmatoid cancer,¹¹ and blood-cyst. In cases of this description minute examination discloses that the cause of the hemorrhage is to be found in the state of the minute vessels and the metamorphoses which the growth has undergone. In the majority of instances, fatty, myxomatous, or hyaline degeneration has taken place, and the adventitia of the vessels is

¹ Ante.² Bull. Soc. Anat. de Paris, ser. 2, vol. ii. p. 241.⁴ Virchow's Archiv, Vol. xxxv. p. 530.⁵ Guy's Hosp. Rep., ser. 3, vol. xx. p. 358.⁶ Ibid., vol. xvi. p. 469.⁸ Prager Vierteljahrschrift, Bd. iv. 1877, p. 14.¹⁰ Lancet, vol. ii., 1876, p. 607.³ Ante.⁷ Ut supra.⁹ Ante.¹¹ Paget, op. cit. p. 758.

the seat of rich cellular infiltration, through which they lose their powers of resistance, become varicose, and finally rupture.

A most striking illustration of sarcomatous blood-cyst, or of hemorrhagic sarcoma, as it is more properly denominated by Virchow, is that recorded by Dr. Weil from the practice of Professor Heine, which presents many points of interest to the pathologist and to the practical surgeon.

CASE VI.—A tailor, aged 19 years, without assignable cause, experienced continuous pain in the left shoulder, which was followed, in fourteen days, by the appearance of a round, firm, fixed, painful tumour in the vicinity of the acromio-clavicular articulation, which in eight days attained the size of a fist and became softer. On admission, or seven weeks after he first experienced pain, the shoulder was the seat of a round tumour of the volume of a child's head, which was, for the most part, soft and fluctuating. The temperature was elevated, the skin was stretched and slightly discolored at one point, and the subcutaneous veins were much enlarged. The swelling was first thought to be a periosteal abscess, but during the next few days, the progressive increase of the growth, and the spontaneous fracture of the surgical neck of the humerus, did much to clear up the diagnosis.

On exploratory incision, which gave vent to much blood, the finger passed into a cavity filled with coagula and broken-down tissue, and the soft tumour felt like a sponge protruding from the broken head of the bone. Amputation at the shoulder-joint was practised two days later, but despite the fact that the axillary artery had, as a preliminary step, been ligated in the first portion of its course, it continued to bleed, and it, as well as upwards of twenty smaller vessels, had to be secured. The infiltrated deltoid muscle, as well as a portion of the great pectoral, and the spine of the scapula required removal.

Fourteen days subsequently, local recurrence was observed to have taken place in the subclavicular region, corresponding to the stump of the great pectoral muscle. The round tumour, which also consisted of blood and broken down tissue, was excised, and the patient was discharged six weeks and a half after the arm had been removed.

On dissection, the growth was found to have originated in the head of the humerus, and to have converted all the soft tissues around the upper third of that bone into a soft hemorrhagic mass. Numerous vessels, many of which were of the size of the radial artery, opened on the inner surface of the cyst, which was partly lined by a lardaceous membrane, and partly limited by softened tissue, both of which were pervaded by thrombosed vessels. Minute examination of the peripheral portions of the tumour showed it to be a very vascular round-celled sarcoma, undergoing, in its softer portions, myxomatous degeneration. The adventitia of the vessels was infiltrated with similar cells in a state of fatty degeneration.

In the case of Mr. Butler, the inner condyle of the femur and the soft, spongy tumour contained within it had been fractured, and the walls of the blood-cyst were formed by the thickened periosteum.

Round-celled sarcomas are liable to the same degenerations as the other forms of central sarcoma. Of these the myxomatous and fatty are the most common. They not infrequently coexist, and give rise to rapidly-growing and enormous tumours, and by rendering them soft and succulent, greatly increase the probability of metastatic deposits in distant organs. Calcareous and ossific transformations are met with in about 17 per cent. of all cases, and hyaline degeneration of the bloodvessels in 9 per cent. In connection with the former, it is interesting to note that one of the two cases in which it occurred was characterized by secondary growths in the lungs.

Spontaneous inflammation of these tumours is rare. In the case of Poland,¹ the thinned and discolored skin gave away at several spots, through which offensive fungous masses protruded. Traumatism, however, is very liable to provoke inflammatory changes, as was witnessed in the case recorded by Teinturier,² in which exploratory puncture was followed by adhesion and superficial ulceration of the skin.

Round-celled sarcomas occur more frequently in the diaphyses of the long bones than do the other forms of sarcoma, the proportion being 33.33 per cent. against 27.27 per cent. for the spindle-celled, and 5.71 per cent. for the giant-celled growths. Their seat in twelve cases was in the

Femur, upper epiphysis, in 3 cases, lower epiphysis, in 2 cases, shaft, in 2 cases.				
Tibia, " " " "	1	"	"	1
Humerus, " " " "	2	"	"	1

Seven cases occurred in females, and five in males. In only two was traumatism assigned as the exciting cause of the disease.

The age at which they were first noticed was, respectively, 9, 19, 19, 22, 24, 27, 28, 32, 34, 35, 40, and 46 years, the average being 28 years, which corresponds very closely with the average age at which giant-celled sarcomas are first observed, although it is eight years earlier than the mean age of occurrence of spindle-celled tumours. They are not so common before the thirtieth year, by 8 per cent., as are myeloid sarcomas, but they are more common before that age, by 20 per cent., than are the spindle-celled tumours.

Round-celled sarcomas grow more rapidly than any other neoplasm of the osseous system, attaining the volume of a child's head in seven weeks,³ or a diameter of seven inches in two months and a half,⁴ or a circumference of thirty-four inches in three years,⁵ the rate of increase being greatest in the soft, fluctuating tumours, and in the hemorrhagic forms. Their growth is continuous and not interrupted, and although it may be comparatively slow at first, it is sure to be quick before its final termination. One patient became pregnant and was delivered, at the full term, of a healthy child, during the progress of the disease, and, as the time advanced, the tumour "visibly increased in size every week." The rate of growth is also greatly influenced by traumatism, whether accidental or intentional, a blow, or exploratory puncture, for example, rendering its increase more acute.

The investing capsule is more liable to spontaneous perforation than in the other forms of central sarcoma. In the cases of Nélaton, and Billroth, the growths also surrounded the shafts of the bones, and in that of Teinturier the tumour protruded into the ham. Fracture of the capsule, through which the surrounding soft structures are liable to become involved

¹ Ante.² Bull. Soc. Anat. de Paris, ser. 2, vol. xli. p. 491.³ Case of Weil.⁴ Case of Nélaton, op. cit. p. 325.⁵ Case of Poland.

in the growth, is not uncommon, that accident having occurred in the cases recorded by Mercier, Bryant, Poland, Lücke, Weil, and Butler.

The locally infectious nature of these tumours declared itself by extensive infiltration of the medulla of the bones in which they originated, in two instances;¹ and by invasion of the surrounding muscles in four cases.² In one case³ the tumor was being prolonged into the corresponding joint, but the cartilage was intact. In those recorded by Bryant and Poland, in both of which the upper extremity of the femur was the seat of the disease, the cartilages of incrustation were undergoing sarcomatous degeneration. In the case of Mr. Bryant, the disease had extended to the floor of the acetabulum through the round ligament; while in that of Mr. Poland, the ligament was sarcomatous only at its root, but the acetabulum and the anterior inferior spine of the ilium were invaded by the morbid tissue. The extension of sarcomatous elements by the ligaments is a point of extreme interest, as it has a direct bearing upon the question of amputating through a joint or at a point higher up. The same occurrence, it will be remembered, was witnessed in Mr. Butlin's osteoid myeloid sarcoma of the upper end of the tibia, in which the disease passed up to the femur through the crucial ligaments.

Enlargement of the neighbouring lymphatic glands was noticed in only three instances. In that of Teinturier, the inguinal glands were normal, and it was only upon dissection that those of the ham were found to be "degenerated." In the case of Bryant, the structure was that of an ordinary lymphatic gland in a state of irritation. In the third case there is no report of the condition of the glands.

Infection of distant organs, or generalization, occurs more frequently in round-celled than in any other central tumour of the long bones. It was met with in 33.33 per cent., or in four of the twelve cases, which I have collected, and of which I append brief abstracts.

CASE VII.⁴—A man, aged 24 years, had suffered, for nine months, from a partly hard and partly fluctuating tumour of the head of the tibia, which had a circumference of eight inches more than the sound limb. After amputation, which proved fatal, from pyæmia, on the fourteenth day, the tumour was found to contain bony plates and spicules, ecchymotic spots, and small clots. The gastrocnemius muscles were infiltrated, and secondary deposits were found in the lungs.

CASE VIII.⁵—A man, aged 36 years, after a severe strain, eighteen months previously, came under Mr. Bryant's care, for a painful, smooth, hard tumour of the hip, which was twice as large as its fellow. On excision, the head, neck, great trochanter, and upper part of the femur were found to be the seat of an alveolar sarcoma, which had invaded the acetabulum through the medium of the round ligament. On death, on the fourth day, the pleura, liver, and kidney, were seen to contain, each, a metastatic nodule; the adductors of the thigh and

¹ Cases of Teinturier and Mercier.

² Cases of Teinturier, Bryant, Poland, and Weil.

³ Case of Teinturier.

⁴ Teinturier, ante.

⁵ Bryant, *Guy's Hosp. Rep.*, ser. 3, vol. xx. p. 360.

the iliacus muscle were infiltrated with small deposits, and a nodule was also detected in the internal obturator muscle.

CASE IX.¹—A woman, aged 34 years, died, without operation, under the care of Mr. Poland, with a fungating hemorrhagic sarcoma, of three years and two months' standing, which was pretty uniformly firm, hard, and inelastic, and had a circumference of thirty-four inches. The tumour, which consisted mainly of blood in various stages of transformation, occupied the upper half of the femur, and had partially invaded the round ligament, the acetabulum, and the iliac bone in the region of the anterior inferior spine. The inguinal glands were free from disease; the femoral vein contained polypoid growths of sarcomatous tissue; several soft masses projected from the surface of the lungs, but were rooted in the pulmonary tissue; and there were also several small nodules present beneath the pleura.

CASE X.—Billroth² disarticulated the arm of a girl, 9 years of age, on account of an alveolar sarcoma of the humerus. The patient had fully recovered from the operation, which was done on the 24th of June, 1865, in four weeks; but at the expiration of one month, secondary growths appeared upon the parietal bone, the occipital bone, and upon each mastoid process. At the time of death, May 20, 1866, shortly before which the sternum also became affected, the first tumour was as large as the fist, and the others were somewhat smaller. They were all at first firm, but latterly they were soft and fluctuating. There was no return in the stump, and there were no signs of lung complications. In addition to the tumours of the osseous system, a soft, dark-brown sarcoma of the size of a large apple was found in the brain. The entire duration of the disease was twenty-two months.

It will be observed that the lungs alone were the seat of metastatic deposits in two cases; that the pleura, liver, and kidneys were affected, but that the lungs escaped, in one; and that the osseous system and brain were involved in the fourth case. In no instance were the intervening lymphatic glands the seat of secondary deposits; while in one example a large vein was filled with the material of the tumour. These facts, taken in connection with those of a similar nature which occurred in the giant- and spindle-celled growths, show conclusively that constitutional contamination takes place through the bloodvessels and not through the lymphatics.

Of 12 cases of round-celled sarcoma, 3 ran their course without amputation. One of these, that of Mercier,³ died of coma, about six months after the appearance of the first symptoms; one, that of Poland,⁴ died of exhaustion and metastatic deposits at the expiration of thirty-eight months; while, in the case of Burchard,⁵ the fatal termination ensued in twenty-seven months from supposed secondary deposits in the lungs. Hence the average duration of life is 23.2 months, which is much shorter than is witnessed in the other varieties of central sarcoma, since in myeloid tumours the mean prolongation of life, when the disease pursues a natural course, is 46 months, and 42 months in spindle-celled sarcoma.

In the remaining 9 cases, 8 of which were subjected to amputation, and 1 to excision, the duration of life, from the first observation of the disease to its termination, varied from two months and a half to five years and a

¹ Guy's Hosp. Rep., ser. 3, vol. xvi. p. 469.

² Chirurgische Klinik, Zurich, 1860-67, p. 453.

³ Ante.

⁴ Ante.

⁵ Ante.

quarter, the average having been 17.6 months. Of the 9 cases, in 5¹ death was directly due to surgical measures; one² recovered from operation, but died, eleven months subsequently, from secondary growths in the brain and skull; and three remained well, respectively, six weeks,³ four months,⁴ and four and a half years⁵ after amputation.

The above facts indicate that round-celled sarcomas run a more rapid course than the other central tumours, the total duration of life after operation in the former being 17.6 months, against 40.9 months for myeloid sarcoma, and 37.2 months for spindle-celled sarcoma.

Round-celled sarcomas are ushered in by pain in 75 per cent. of all cases, and by the appearance of a tumour alone in 25 per cent., but in two-thirds of the latter suffering declares itself later. In one instance only was pain altogether absent. In the majority of cases it is continuous and severe, and increased by motion. The skin is variously altered in 41 per cent. of all cases, being merely stretched, but movable, in the great majority, and rarely discolored. The subcutaneous veins are enlarged in the same ratio, but only to a marked degree in about one-half of the cases. Spontaneous fracture occurs in 50 per cent. of all instances. In three an accident of this nature, preceded by pain in the part, and followed by the appearance of a tumour, which continued to increase, led Mercier, Bryant, and Heine, to diagnose malignant disease.

The tumour itself is usually smooth, spherical, or ovoid, and soft and moderately elastic in consistence, although it may be the seat of obscure and deep fluctuation. In rare cases its consistence is firm. On exploratory puncture, the instrument moves about freely, and blood escapes at the opening. The temperature is noted to have been elevated in one instance.⁶ In four cases, or 33.33 per cent. of all cases, pulsation was present. In two of these the disease was thought to be aneurism, and in one the femoral artery was actually ligated. It is interesting to note that in three of these instances the shaft of the long bones was the seat of the tumour.

Pulsation occurs much more frequently in round-celled than in giant-celled sarcoma, and nearly three times as often as in spindle-celled sarcoma. In giant-celled tumours, however, pulsation was observed in those cases only in which the articular extremities of the long bones were affected; while, in round-celled tumours, that sign was met with three times when the shaft was affected, and only once when the epiphysis was the seat of the disease. Hence pulsation, when taken in connection with other symptoms, is a valuable point in the differentiation of these two forms of sarcoma.

¹ Cases of Nélaton, *op. cit.* p. 325; Teinturier, Bryant, Butler, and Billroth (*Chir. Klinik*, p. 568).

² Billroth, *ante.*

³ Weil, *ante.*

⁴ Bryant, *ante.*

⁵ Lücke, *ante.*

⁶ For elevation of temperature in sarcomas consult a paper by Professor Estlander, *Trans. International Med. Congress of Philada.*, 1876, p. 658.

In conclusion, an immovable, bulky, rapidly growing, painful, soft, pulsating tumour, especially if seated in the shaft of a long bone, occurring at about the 28th year, and attended with fracture, and, possibly, the protrusion of a fungous mass, and enlargement of the subcutaneous veins, but without discoloration of the skin or involvement of the lymphatic glands, may be said to be a central round-celled sarcoma.

The treatment is limited to early amputation, practised as close to the trunk as may be consistent with the safety of the patient. If the tumour involves an epiphysis, the limb should not be removed through the corresponding articulation, as it is liable to be invaded by the morbid growth.

The Differential Diagnosis of Central Sarcomas.—Myelogenic sarcomas, especially when they increase rapidly, are liable to be confounded with each other. Hence, as an aid to their discrimination, I have set forth their affinities and contrasts in the following table :—

	Giant-celled.	Spindle-celled.	Round-celled.
Frequency of occurrence	71.42 p. c.	16.32 p. c.	12.24 p. c.
Appear before the 30th year	66.66 “	37.5 “	58.33 “
Seated in the shaft of the long bones	5.71 “	27.27 “	33.33 “
Ushered in by pain	50 “	60 “	75 “
“ “ swelling	19 “	30 “	25 “
“ “ “ and pain	31 “	10 “	0 “
Pain throughout the disease	40 “	100 “	91 “
Skin variously altered	33 “	40 “	41 “
Subcutaneous veins enlarged	27 “	50 “	41 “
Infection of adjacent tissues	12 “	18 “	66 “
Lymphatic glands tumefied or involved	16 “	0 “	25 “
Metastatic deposits	22.72 “	23.07 “	33.33 “
Local recurrence	8 “	20 “	25 “
Pulsation	20 “	12.5 “	33.33 “
Joints invaded	14 “	25 “	25 “
Fracture, spontaneous, or from slight causes	4 “	44 “	50 “
Duration of life without operation	46 mos.	42 mos.	23 mos.
“ “ with “	40.9 “	37.2 “	17.6 “
“ “ “ “ and remain- ing well }	54.8 “	64 “	24 “

An inspection of the foregoing clinical features shows that all the varieties of central sarcoma are malignant, and that the degree of malignity is, commencing with the lowest in the scale, in the order named. It is curious, however, to observe that the myeloid growths occur at an earlier age, and are marked by sympathetic lymphatic involvement nearly two-thirds as frequently as the round-celled, which are the most pernicious. It is also notable that in the spindle-celled tumours, the lymphatic glands are never enlarged, and, as this statement is almost true of the same variety as met with growing from the periosteum, it forms an important point in the diagnosis. The apparent discrepancy in the duration of life

of those surviving surgical interference between the giant and spindle-celled sarcomas, is due to the fact that in one of the latter life was prolonged for seven years, and the cases were much less numerous.

It will also be seen, and this also is an important aid in the differential diagnosis, that a central sarcoma occupying the shaft of a long bone is far more likely to be a round-celled or a spindle-celled, than a giant-celled growth. Although pulsation is more frequent by 13 per cent. in round-celled tumours than in those composed of multinucleated elements, it is remarkable that in the former the shafts of the bones were affected in three of the four cases in which that sign was noticed, whereas the epiphyses alone were involved in the latter. In the two instances of spindle-celled sarcoma the pulsating tumour was seated in the shaft in one and in the articular extremity in the other. Hence if a pulsating central sarcoma is observed in the diaphysis of a long bone, the chances are three to one that it is composed of round cells, and that in no instance is it a myeloid tumour. If, on the other hand, the epiphysis of a long bone is occupied by a pulsating growth, the chances are ten to one that it belongs to the giant-celled variety.

Of the remaining central neoplasms of the tubular bones the only one that is liable to occasion errors in diagnosis is enchondroma. When compared with the sarcomas it is of far less frequent occurrence, as it forms only 14 per cent. of all cartilaginous tumours, while 59 per cent. of all sarcomas originate in the medulla. It is less painful, of slower growth, of firmer consistence, and has a nodulated or bosselated surface, which is rarely witnessed in sarcoma unless the capsule is perforated, or the morbid material is the seat of cystic degeneration or extensive hemorrhages, when, in addition, the tumour is soft. Enchondroma, moreover, is more common in males; it never occurs so early or so late in life as the sarcomas; and it appears, on an average, four years sooner than the latter. It does not pulsate, invade the joints, nor does it fungate, although in 20 per cent. of all instances the overlying integuments ulcerate and the degenerated fluid contents escape, to the amount even of thirty-two quarts, as in an example recorded by Nélaton.¹ Enchondromas are very liable to undergo mucoid softening and cystic degeneration, those changes having occurred in 60 per cent. of all instances, in consequence of which they not only attain a huge volume,² far greater, indeed, than do the sarcomas, but are also attended by frequent enlargement of the subcutaneous veins. Finally the central chondromas do not give rise to metastatic deposits.

For convenience of reference the characteristics of these affections are given in the subjoined table.

¹ Gazette des Hôpitaux, No. 13, 1855, p. 50.

² In the cases of Nélaton and Crampton, for example, the thigh measured, in the first, nearly six feet, and, in the second, six feet and a quarter in circumference.

CENTRAL CHONDROMA.¹

1. Forms 14 per cent. of all cartilaginous tumours.
2. Appears between the seventeenth and fifty-ninth years, the average being the thirty-third year.
3. Eighty per cent. of all cases occur in males.
4. Grows comparatively slowly; but may acquire a huge bulk.
5. Usually begins insidiously, but pain is present throughout in 30 per cent. of all cases.
6. The subcutaneous veins are enlarged in 60 per cent. of all cases.
7. The skin is variously altered in 20 per cent. of all cases.
8. The lymphatic glands are enlarged in 10 per cent. of all cases.
9. Spontaneous fracture, or fracture from slight causes, is met with in 20 per cent. of all cases.
10. Metastatic deposits, or general dissemination of the disease, do not occur.
11. Never pulsates.
12. Does not invade the joints.

CENTRAL SARCOMA.²

1. Forms 59 per cent. of all sarcomas.
2. Appears between the ninth and sixty-eighth years, the average being the twenty-ninth year.
3. Fifty-six per cent. of all cases occur in males.
4. Increases comparatively rapidly, and never attains so large a size.
5. Generally ushered in by pain, and suffering is present throughout in 60 per cent. of all cases.
6. The veins are enlarged in only 30 per cent. of all cases.
7. The skin is altered in 37 per cent. of all cases.
8. The lymphatic glands are enlarged in 14 per cent. of all cases.
9. That accident occurs also in 20 per cent. of all cases.
10. Secondary deposits are met with in 25 per cent. of all cases.
11. Pulsation is observed in 20 per cent. of all cases.
12. The joints are involved in 18 per cent. of all cases.

As the distinction between aneurism, white swelling, and sarcoma of the bones was dwelt upon in my first paper, it need not be referred to again.

II. *Periosteal Sarcomas.*

The peripheral, periosteal, or periosteal sarcomas include those which originate in the soft osteogenic layer of the periosteum, in contradistinction to the tumours which are attached to the outer fibrous layer of that membrane, which should rather be considered as parosteal growths, or sarcomas developed in the tissues surrounding the bone and affecting the periosteum secondarily. In the true peripheral sarcomas, the tumour is seated between the bone and periosteum, the latter of which is constantly regenerating itself to form a limiting capsule for it, which persists unchanged in the firm sarcomas, but is liable to be transformed into tumour elements in the soft sarcomas, through which it may finally be destroyed,

¹ Based upon an examination of ten cases.

² Based upon an examination of seventy-eight cases.

and allow the disease to invade the adjacent tissues. The bone itself upon or around which the growth is seated may be entirely normal, or be partially absorbed, and present numerous cavities through local infection of its cortex. Now and then it is rendered so brittle that it fractures from very slight causes; in other cases, the medullary canal and the spongy substance of the epiphysis are the seat of new deposits from the extension of the disease along the Haversian system.

Periosteal sarcomas, so far as my investigations go, never form myeloid tumours, although a few giant cells may be detected at the points where the bone has been destroyed. In their histological construction, they are either made up of a spindle-celled or a round-celled tissue, which evince a remarkable tendency to calcification or ossification of their intercellular substance, which is easily explained by their point of origin. In many instances the deposition of the early salts and ossification proceed to such an extent, that, when the softer portions have been removed by maceration, a bony skeleton or framework is left, which might be mistaken for spongy exostoses or osteophytes.

Periosteal sarcomas, which have not undergone these transformations, are comparatively rare. Thus of 67 specimens or histories that I have examined, 9, or 13 per cent., were composed of more or less pure spindle-celled tissue, 13, or 19 per cent., of round-celled tissue, while not less than 45, or 67 per cent., were instances of ossifying and calcifying tumours.

In a general way, periosteal sarcomas may be distinguished from the central sarcomas, by their relative infrequency, by their occurrence earlier in life, the average age at which they appear being $22\frac{1}{2}$ years, by their marked malignity, which is greater by 43.5 per cent. than in the myelogenic tumours, by the more frequent implication of the lymphatic glands, by the excessive suffering which they awaken, and by their disposition to calcareous and ossific transformations, which is greater, by 47 per cent., than in the central growths. They are not contained in bony capsules, are not so liable to extensive effusions of blood, and they evince little tendency to invasion of the joints, to pulsation, and to fracture from slight causes. Thus, while extension into the articulations, pulsation, and fracture occur in the central sarcomas in the proportion respectively of 18 per cent., 20 per cent., and 20 per cent., these features are only met with in 7 per cent., 1.8 per cent. and 5 per cent. of the peripheral tumours.

In accordance with the plan that I have followed in the study of the central sarcomas, I shall analyze those of periosteal origin, dividing them into the round-celled and spindle-celled, and making a separate group of the osteoid tumours, as a good deal of confusion still exists as to their true nature.

1. *Round-celled Sarcoma.*

In their histological construction, degenerations and combinations, and appearances on section, periosteal round-celled sarcomas do not differ ma-

terially from those of a similar structure which arise in the medulla. Of the thirteen cases that I have examined, seven were of the ordinary granulation type, four were alveolar, and two were of the lymphadenoid variety. While they grow as rapidly, and kill as quickly as do the central sarcomas, they occur at an earlier age, are most common in males, evince greater disposition to local infection and metastatic deposits, contaminate the associated lymphatic glands, and produce changes in the skin more frequently, and elevate the local temperature in a much larger proportion of the cases. Unlike the central round-celled tumours, they very rarely occasion fracture of the affected bone, never pulsate, nor are they the seat of such extensive extravasations of blood.

Excellent illustrations of the structure and of the great rapidity of the growth of these neoplasms are afforded by the following cases:—

CASE XI. A youth, nineteen years of age, on the 7th of July, 1872, accidentally struck his left arm above the elbow, but the injury, which was followed by slight ecchymosis, was productive of so little inconvenience that he continued his work about the farm. Five weeks and a half subsequently he first noticed a tumour, about as large as a pullet's egg, at the site of the blow. This rapidly enlarged, and, on the 9th of November of the same year, or at the expiration of four months, when he was admitted into the hospital of the Jefferson Medical College, it measured, at a point

Fig. 4.



seven inches above the inner condyle, twenty inches in circumference, or thirteen inches more than the opposite limb at a corresponding point, while its length was nine inches. Its growth was painless throughout; the entire limb was very œdematous; the temperature was elevated; the subcutaneous veins were immensely enlarged; the skin was discolored and adherent; and its consistence was soft and apparently fluctuating. One morning, about six weeks before admission, he noticed that the humerus had given way during the previous night. There was no glandular involvement; the patient had a good appetite, and slept well, but the pulse was irritable and weak; the face was sallow and anæmic, and he was much emaciated. The mass had been punctured one week previously under the supposition that it was an abscess, but blood only followed the withdrawal of the knife. Amputation at the shoulder-joint by cutaneous flaps was performed, after a few days of preliminary treatment, by Professor Gross, but the patient expired from exhaustion five hours after the operation.

After the soft parts were removed, the tumour was found to be lobulated and to be contained in a perfect periosteal capsule. As may be seen from Fig. 4, it grew principally from the outer and posterior surfaces of the bone, the projection from the inner surface being comparatively slight. It surrounded the entire humerus with the exception of two inches of its upper extremity, and three

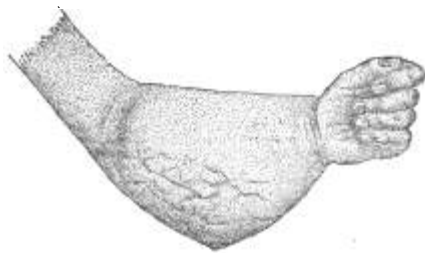
inches of its lower end, and measured seventeen inches in its greatest circumference. On laying open the capsule the great mass of the neoplasm was found to consist partly of a soft pinkish-white or brain-like tissue, dotted here and there with small vascular points, and partly of hæmatoid substance, which closely resembled an organizing thrombus. Indeed, the likeness to the hæmatoid variety of medullary sarcoma was most striking. Scattered throughout the tissue, but not in great numbers, were cysts with gelatinous contents. The humerus was fractured at two points, which corresponded with the junction of the middle with the upper and lower thirds, and its surface was deeply eroded, the loose fragment especially presenting a worm-eaten appearance. The overlying muscles were adherent to the capsule, and had a pale and gelatinous look.

Very numerous sections from different portions of the growth disclosed that it was composed of lymphadenoid tissue, which differed in nowise from that delineated in Fig. 2. The muscles adherent to the periosteal capsule had become infiltrated by the elements of the tumour. Their fibres were very friable, and had undergone incipient fatty transformation, as was indicated by molecular infiltration and the absence of transverse striation. The interfascicular connective tissue was pervaded by granular lymphoid cells, the nuclei of which became apparent on the addition of acetic acid; but I failed to discover any participation of the nuclei of the muscles in the morbid action. A few giant cells were found in the tissue which filled the cavities of the eroded bone.

CASE XII. In a second example, which was also under the charge of Professor Gross, the structure was precisely similar. The soft, elastic, pyriform, and slightly lobulated tumour, which was of ten months' standing, and traceable to a blow, surrounded the head of the tibia of a lad fourteen years of age. The skin was thin and shiny, but mobile; the subcutaneous veins were greatly enlarged, and the temperature much elevated. The material of which it was composed had the consistence and appearance of the brain of a newly-born child; but was soft at points, and the seat of extensive extravasations of blood. The boy died, nine months after amputation through the lower third of the thigh, with chest symptoms; and, although a post-mortem examination could not be obtained, it was presumed that the lungs were the seat of metastatic deposits.

CASE XIII. In a third instance, which I saw with Dr. Collins, surgeon to the German Hospital of this city, the tumour was composed of a mass of small, round lymphoid cells, with scarcely any visible intercellular substance, which was pervaded by a large meshed, lozenge-shaped network of capillaries with very thin walls. It was met with in a boy nine years of age, at the site of a fractured ulna, the accident having occurred one year previously. It extended, as may be seen in Fig. 5, from the wrist to the elbow, and measured eight inches and a half more in its greatest circumference than did the corresponding point of the opposite arm. The skin was natural except at the most dependent part of the growth, where it was thin and injected, particularly around a nipple-shaped eminence, where a puncture had been made eight weeks previously. The subcutaneous

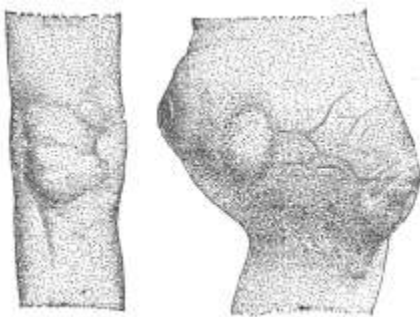
Fig. 5.



veins were prominent over the anterior or palmar face of the mass, which was developed principally at the expense of the ulnar aspect of the forearm, being very prominent in front and behind, while the radial side preserved its natural outline. The tumour was fusiform in shape, but more bellied on its ulnar side; its consistence was elastic, and, at points, apparently fluctuating, and its surface was somewhat bosselated. There was neither pain nor tenderness, but the temperature was elevated. The axillary glands were markedly enlarged. After amputation the tumour measured six inches in length and four inches and a half in width. It had developed at the site of the fracture, which was at the middle of the ulna, and was of periosteal origin, although that membrane was lost in the middle of the mass. The upper and lower epiphyses of the bone were not involved. The brain-like tissue, of which the tumour was composed, was soft and easily crushed, undergoing limited cystic transformation, and pervaded by injected vessels and hemorrhagic deposits. Unfortunately the history of the case is incomplete, as Dr. Collins informs me that the boy died of lung symptoms eight months after he removed the limb, and was buried before he was aware of his decease.

CASE XIV. A woman, four months pregnant, and aged thirty-three years, came to my clinic at the Jefferson Medical College Hospital on the 3d of August, 1878, with a soft, fluctuating tumour of the lower extremity of the left femur, which was most prominent internally and posteriorly, there being little enlargement on the outside of the thigh. Its summit was the seat of two bosses, the larger of which was superficially ulcerated to the extent of a twenty-five cent piece. In this situation the skin was thin, red, adherent, and pervaded by small vessels. Elsewhere it was mobile, stretched, and shining. A few subcutaneous veins were enlarged, and there was a gland in the situation of the saphenous opening of the size of a lemon. The temperature, taken with Seguin's surface thermometer, indicated 98° , while that of the sound limb was only 94° . The tumour, which is delineated in Fig. 6, extended six inches and a half above the patella,

Fig. 6.



and measured ten inches more in circumference than the sound limb. The patient stated that she was seized, without assignable cause, two years previously with spasmodic pain in the situation of the inner condyle, which persisted and increased in frequency, and was followed, eight months subsequently, by the appearance of a small lump, which grew slowly but continuously, until three months ago, when it increased rapidly. At that time she first noticed the glandular enlargement, and one

month afterwards the skin broke. The leg was œdematous; the tumour was painful and somewhat tender, and she had lost flesh and appetite. As she declined surgical aid, she returned home unrelieved, and I was subsequently informed that the mass had given way ten days subsequently at the point of ulceration, and had been the seat of fatal hemorrhage. Although there was no minute examination, from a careful study of similar cases I

assume it to have been an example of round-celled tumour. I have, however, not included it in the study of the general pathology of the disease.

As the microscopic appearances, consistence, and degenerations of the periosteal round-celled sarcomas do not differ from those of the central round-celled tumours, they need not detain us. Spontaneous inflammation occurred in only two instances: In that of Poinso¹ the skin gave way, and a fungus protruded; while in my own case, as I have just observed, the superficially ulcerated integument opened, and profuse bleeding ensued.

Periosteal round-celled sarcomas surround the shafts much more frequently than the epiphyses of the long bones. Their seat in 13 cases was around the

Humerus, shaft,	in 4 cases.
Femur, “	in 2 cases, lower epiphysis in 2 cases.
Tibia, “	in 1 case, upper “ in 2 “
Ulna, “	in 1 “
Tibia, “	in 1 “

Ten cases occurred in males, and three in females. In seven, or 54 per cent., the tumour was traceable to traumatism.

The age at which they were first noticed was, in eleven instances, respectively, 7, 10, 14, 14, 19, 25, 27, 32, 32, 36, and 40 years, the average being 23.2 years, or five years earlier than in the central round-celled tumours.

Their growth is usually continuous and rapid. Thus, they may attain the size of a double fist in twelve weeks, or a circumference of thirteen inches more than the sound limb in four months. In the case recorded by Poinso¹, on the other hand, a small growth of the shaft of the tibia had existed for several years, and had increased very slowly, when it took on renewed action, and acquired the volume of two fists in six months.

Local infection of the adjacent structures is quite common. The soft tissues were invaded in 50 per cent. of all cases. In two instances the subjacent bone was eroded; in two it was not only eroded, but the medullary canal was the seat of tumour tissue; while in one case,² in which the tumour corresponded to the lower half of the tibia, that bone was destroyed to the extent of two inches, an encysted nodule was discovered in its tuberosity, and the superficial portions of the fibula were ulcerated. Hence, the bone itself is implicated in the disease in 38 per cent. of all instances.

In a remarkable case, recorded by Steudener,³ the knee-joint was perforated by a growth which sprang from the anterior surface of the head of the tibia, and gave rise to diffuse sarcomatous degeneration of the synovial membrane and the subcrural bursa. In an instance of round-celled tumour of the inner condyle of the femur, reported by Bryant,⁴ the growth bulged

¹ Bull. et Mém. de la Soc. de Chir., vol. iii., 1877, p. 208.

² Ibid.

³ Virchow's Archiv, vol. xlv. p. 500.

⁴ Guy's Hosp. Reports, ser. 3, vol., xxii. p. 318.

into the joint without opening it. In neither case was the cartilage involved. Enlargement of the associated lymphatic glands was observed in 5 cases, or 38.46 per cent. of the entire number. In two of these, the state of the glands was not noticed. In two,¹ it is very probable that they were merely swollen from irritation, as the patients were alive, respectively, fourteen and forty months after amputation of the thigh; while in one,² which was an example of alveolar sarcoma, the femoral glands showed tumour elements.

General dissemination of the disease, or the occurrence of secondary growths, was met with once, and it was presumed to have taken place in three of the eight cases in which the histories are finished. Unfortunately, in none of these was there a post-mortem inspection, but there can be no doubt that the lungs were affected in all. In the case of Labbé³ there was also recurrence in the stump; while in one, recorded by Barwell,⁴ in which excision of the upper portion of the humerus, including its head, was practised for a growth of eleven weeks' standing, in a lad, aged ten years, the disease returned about the acromion process in three weeks.

All of the cases of periosteal round-celled sarcoma were subjected to operation, save one, which ran a natural course; but its history is too incomplete to be of any service. Of the remaining twelve, ten underwent amputation and two excision, the latter being confined to the shoulder-joint, and in both there was recurrence in the stump as stated above. Of the twelve cases, in four the histories are not perfect. Hence, in eight cases, the duration of life, from the first observation of the disease to its termination, varied from two months and a half to five years and one-third, the average having been eighteen months, so that there is no difference in the duration of life of patients afflicted with round-celled tumours, be they of peripheral or central origin. Of the eight cases, in two⁵ death was directly due to surgical measures; one recovered, but died from metastatic deposits at the expiration of thirty-two months;⁶ three⁷ recovered, but died subsequently from supposed systemic infection, respectively, at seven, eight, and nine months; one⁸ was alive with local recurrence at the end of three weeks; and one⁹ remained well for forty months. Hence, six patients recovered from surgical interference, but of these only one remained well without local recurrence,¹⁰ while one died of generalization, and three subsequently succumbed from supposed metastatic deposits. Taking

¹ Cases of Poinot and Bryant.

² Hutchinson, *Trans. Path. Soc., Lond.*, vol. xxvii. p. 265.

³ *Bull. et Mém. de la Soc. de Chir.*, vol. iii., 1877, p. 211.

⁴ *Trans. Path. Soc., Lond.*, vol. xxvi. p. 168.

⁵ Case XI. p. 358, and Case of Hutchinson.

⁶ Reference mislaid.

⁷ Cases XII. and XIII. p. 359, and Case of Labbé.

⁸ Case of Bryant.

⁹ Case of Barwell.

¹⁰ Case of Bryant.

these statements as the basis upon which to grade the malignity of these growths, it will be perceived that they are destructive to life in 66.66 per cent. of all instances.

Periosteal round-celled sarcomas make themselves known by pain in 55 per cent. of all instances, and by the appearance of a tumour alone in 44 per cent. In 66 per cent. pain is present throughout the entire course of the disease, while it is absent in 33 per cent. The skin is adherent, discolored, or ulcerated in 51 per cent.; the subcutaneous veins are enlarged in 41 per cent.; the temperature is elevated in 33 per cent.; the lymphatic glands are tumefied in 38.46 per cent.; and spontaneous fracture occurs in 7 per cent. of all cases. Pulsation is never present.

Finally, a rapidly-increasing, painful, lobulated, soft, elastic, non-pulsatile, pyriform or fusiform tumour, especially if seated on the shaft of a long bone, occurring at about the twenty-third year, and unaccompanied by fracture, but marked by discoloration of the skin, enlargement of the subcutaneous veins, involvement of the lymphatic glands, and elevation of temperature, may be safely ranked among the periosteal round-celled sarcomas.

2. *Spindle-celled Sarcoma.*

Peripheral sarcomas, composed of fusiform cells, differ clinically from those made up of similar elements of central origin, by their greater frequency in males, by their occurrence at a far earlier age, by their non-pulsation, and by their indisposition to invade the joints. The subcutaneous veins are not so often enlarged; the skin is less liable to be altered; fracture of the involved bone is incomparably less common, while general dissemination is constant, since all the subjects die, sooner or later, of secondary visceral contamination, whether they are subjected to operation or not.

Inflammation of these tumours is so rarely met with that superficial ulceration of the skin occurred in only one instance.¹ They are, however, more disposed to cystic degeneration than are the central growths, through which they may assume a gigantic size, as happened in the case of Langenbeck, which I will quote presently. Mucous cysts are present in 33 per cent. of all instances, while a large cyst containing blood was found in one case,² or in 11 per cent. of the entire number.

Periosteal spindle-celled sarcomas, unlike the peripheral round-celled tumours, surround the epiphyses more frequently than the shafts of the long bones. Their seat in nine cases was around the

Femur, lower epiphysis,	in 3 cases,	shaft,	in 2 cases.
Humerus,		" " 2 "	
Tibia, upper	"	in 1 case.	
Ulna, lower	"	" 1 "	

¹ Jackson, Trans. Path. Soc. Lond., vol. xviii. p. 215.

² Butlin, Ibid. vol. xxv. p. 210.

Five cases occurred in females, and four in the opposite sex ; and three, or 33 per cent. were due to traumatism.

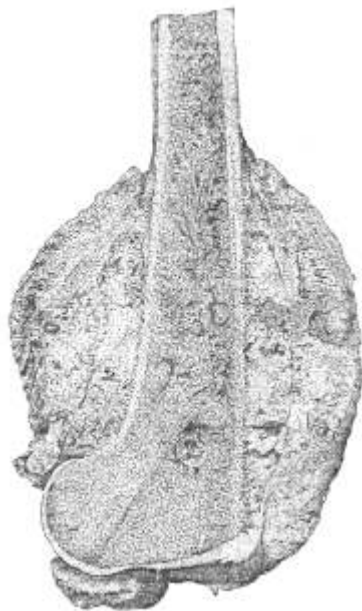
The age at which they were first noticed was, respectively, 15, 16, 19, 21, 21, 23, 28, 34, and 41, the average being 24.2, or 12 years earlier than in the central spindle-celled growths.

Their growth is, as a rule, uninterrupted and comparatively slow. In the case of Mr. Nunn,¹ the tumour remained stationary for one month, and at the date of amputation, or three months after its detection, it had increased at the rate of half an inch a week. In the remarkable case of Mr. Jackson,² to which reference will again be made, not only did the further progress of the tumour cease for a number of years, but it appears as if it had developed from a fibroma. Thus, at the age of nine years, a girl detected a small, flat, painless growth, one inch long, on the inner side of the knee, which grew somewhat up to her thirteenth year, and afterwards more slowly, until, at the age of twenty-four, it was of the size of a large walnut. From this date up to her forty-first year, it did not increase a particle, when the woman fell on both knees, in consequence of which it took on renewed activity, and a large medullary tumour resulted.

Local infection of the surrounding tissues and the lymphatic glands is comparatively uncommon. The skin was invaded in one instance ; the

muscles in two ; the involved bone was superficially eroded in one, and fractured in one. In none of the nine cases did the disease extend to the medullary canal, and in none was the corresponding joint involved. In a specimen of large spindle-celled sarcoma of the lower end of the femur, however, which is from the cabinet of Professor Gross, but which is devoid of history, the medullary canal, to an extent corresponding to the external tumour, is infiltrated with a pearly tissue, which terminates, as is shown in Fig. 7, above the upper limit of the tumour in a conical mass, which is made up of fragile radiating fibres. At the junction of the shaft with the epiphysis the new tissue has undergone softening, and projecting into the joint from the intercondyloid notch, along the side of the external

Fig. 7.



¹ Trans. Path. Soc. Lond., vol. xxi. p. 339.

² Ante.

crucial ligament may be seen a pedunculated lobulated growth, of the shape of a kidney and as large as half a hen's egg. In only one instance, that of Mr. Butlin,¹ were the glands enlarged; but as they subsided in great part after amputation, the inference is fair that they were merely the seat of irritative hyperplasia.

Metastatic deposits occurred in four of the five cases in which the histories are complete, while in one there was local return in the stump and the patient died with symptoms indicative of visceral contamination. In the case of Mr. Jackson,² the patient recovered from amputation, but died thirteen months afterwards from secondary growths of the brain. In that of Mr. Butlin,³ which was an example of the hemorrhagic form of the affection, amputation of the thigh was practised for a tumour of the lower end of the femur of eight months' duration. At the expiration of five months, the limb was removed at the hip on account of recurrence in the stump, which was noticed one month previously, or four months after the first operation; but death ensued from presumed secondary disease of the viscera in less than a month. In the case of Allin,⁴ in which disarticulation of the humerus was practised for a tumour of four months' standing, the disease returned in the stump in eight weeks, which fungated, and death occurred six months after the operation. Almost the entire scapula was involved in the recurrent growth, the lungs were pervaded by metastatic tumours, and the retroperitoneal lymphatic glands were extensively involved. In the instance recorded by Mr. Nunn,⁵ in which amputation was done for a growth of the lower third of the femur, which had existed only three months, death ensued from pyæmia on the sixth day, when "enlarged, soft, and dark-coloured glands were found in the groin and in the pelvic and lumbar regions."

The fifth and last example of the general dissemination of the disease, which occurred in the practice of Langenbeck,⁶ is so remarkable that it deserves a somewhat more extended notice.

CASE XV. A man, 23 years of age, in 1855, suffered from rheumatoid pains in the right arm, which prevented him from working. In 1857 he fell and broke the humerus, but the fracture united in four weeks. Six months subsequently, a tumour began to grow rapidly at the seat of the injury, and, in November, 1859, it reached from the neck of the humerus to within three inches of the elbow, and measured three feet in its greatest circumference. The skin was merely greatly stretched, and the tumour was hard at some points and fluctuating at others. The man was very anæmic and had no sleep from pain. After disarticulation at the shoulder, two years and a half after the fracture, the mass was found to be a fibrous sarcoma, containing scattered nodules of cartilage and many cysts, one of which contained a gallon of mucoid fluid. Recovery ensued, but local recurrence soon set in, and on his return in April, 1860, or five months subsequently, when his gene-

¹ Ante.

² Ante, and Trans. Path. Soc., Lond., vol. xix. p. 33.

³ The Medical Record, Feb. 9, 1878, p. 116.

⁴ Langenbeck's Archiv, vol. iii. p. 340, and case 104, p. 306, and Deutsche Klinik, 1860, p. 217.

ral health was much improved, the scapula was found to be involved in a hard tuberos tumour. After preliminary ligation of the subclavian artery, the entire scapula, along with an inch and a half of the acromial end of the clavicle, was extirpated, and the growth was discovered to be of the same nature, but devoid of cartilage or cysts. Death ensued a year and a half afterwards from deposits in the lungs.

All of the patients underwent operation, but in four the histories are too incomplete to be of any use in determining the degree of malignity of these formations. In five, of which I have just given abstracts, there were metastatic deposits, and in three of these there was local recurrence. Hence, periosteal spindle-celled sarcomas may be regarded as the most pernicious of all the sarcomas, as every case is characterized, at some time or other, by malignant features.

The total duration of life from the first appearance of the disease until its termination after operation, varied from three to forty-eight months, the average having been twenty months, or seventeen months less than the mean life of the central spindle-celled tumours.

Periosteal spindle-celled sarcomas usually form dense, hard, smooth tumours, which are, however, soft, or of varying degrees of consistence, and lobulated, when they have perforated their capsules. They are ushered in by pain in 85.7 per cent. of all cases, and by a tumour alone in 14.2 per cent. Suffering is never absent, and at times it is almost unbearable. The skin is variously altered in 22 per cent., and the subcutaneous veins are prominent in 33 per cent. of all cases, while sympathetic enlargement of the lymphatic glands occurs in only 11 per cent. Pulsation is never observed, and fracture from slight causes is found in 11 per cent. of all instances.

Finally, a firm, slowly growing, painful, and non-pulsating tumour, occurring at about the twenty-fourth year, and not attended by fracture, lymphatic involvement, or discoloration of the skin, but with possible enlargement of the subcutaneous veins, may be regarded as a periosteal spindle-celled sarcoma.

3. *Periosteal Osteoid Sarcoma.*

As a result of the remarkable disposition evinced by periosteal sarcomas to undergo calcareous infiltration or ossification of their intercellular substance, a variety has arisen which, even at the present day, is very imperfectly understood, and is generally spoken of as osteoid cancer. In his memoir on the subject, published in 1843, Müller,¹ while recognizing the existence of osteoid carcinoma, described under the name of "Osteoid Tumour," or "Ossifying Fungus," a particular kind of ossifying connective-tissue tumour, which differed histologically from carcinoma, although it gave rise to secondary deposits of a similar nature in the lymphatic glands and the internal organs. Two years subsequently, Lebert² curiously

¹ Müller's Archiv, 1843, p. 396.

² Physiologie Pathologique, vol. ii. p. 231.

enough included the osteoid tumour of Müller among the homœomorphous or benign formations; and Stanley,¹ in 1849, designated the disease "Malignant Osseous Tumour." In their works which appeared between 1852 and 1857, Gerlach,² Paget,³ Schuh,⁴ Wedl,⁵ and Rokitsky,⁶ described the calcifying and ossifying sarcomas as "Osteoid Cancer;" but, in 1858, Volkmann⁷ again made the distinction between osteoid sarcomas and osteoid carcinomas, in which view he was sustained by Virchow,⁸ and since that date the majority at least of so-called osteoid cancers are classed among the sarcomas by the German pathologists.

Among the more recent writers, Green⁹ and Arnott¹⁰ very properly speak of osteoid cancer as a variety of sarcoma; while Wilks and Moxon,¹¹ on insufficient grounds, as it appears to me, are inclined to believe that most of these tumours are osteoid chondromata. Cornil and Ranvier¹² describe ossifying sarcomas and ossifying enchondromas, and, with Virchow, treat of osteoid chondroma as a variety of cartilaginous tumour, the structure of which is similar to that found beneath the periosteum of rachitic bones.

To add still more to the existing confusion, Broca¹³ regards these growths as periosteal exostoses developed in cancerous subjects; and Holmes¹⁴ describes a remarkable example of constantly recurring osteoid sarcoma under the title of "Diffused bony, or innocent osteoid, tumour," which is included by Paget in his description of osteoid cancer. Paget,¹⁵ indeed, still believes "that the most probable view of the nature of osteoid cancers would be expressed by calling them ossified fibrous or medullary cancers, and by regarding them as illustrating a calcareous or osseous degeneration." His opinion, however, is based upon the course pursued by the disease, and not upon histological features, since the minute structure, as depicted by him, corresponds in nowise with that of carcinoma. How many of the cases which I have analyzed are included in his history of these growths, I am unable to say; but that he has mistaken sarcoma for carcinoma is rendered quite certain by his reference to a case in which microscopic examination, made by Dr. Hillier, disclosed "fibroplastic growths, with abundance of elongated nuclei, and most perfect

¹ A Treatise on Diseases of the Bones, p. 163.

² Der Zottenkrebs und das Osteoid, Mainz, 1852.

³ Op. cit., 1st ed., 1853.

⁴ Path. und Ther. der Pseudoplasmen, pp. 147 and 425.

⁵ Grundzüge der Path. Histologie, 1854, p. 639.

⁶ Wochenblatt d. Zeitschrift d. Wiener Aerzte, Jahrg. 3, No. 1, 1857.

⁷ Bemerkungen über einige von Krebs zu trennende Geschwülste, Halle, 1858.

⁸ Deutsche Klinik, No. 49, 1858, p. 481.

⁹ An Introduction to Pathology and Morbid Anatomy, Phila., 1876, p. 114.

¹⁰ The Histology and Diagnosis of Cancer, 1872, p. 57.

¹¹ Lectures on Pathological Anatomy, Phila., 1875, p. 54.

¹² Op. cit. pp. 129 and 217.

¹³ Traité des Tumeurs, Paris, 1866, vol. i. p. 97.

¹⁴ A System of Surgery, 2d ed., vol. iii. p. 825.

¹⁵ Op. cit., 3d ed., p. 759.

specimens of fibre cells."¹ In other words, the neoplasm was a calcifying spindle-celled sarcoma.

From his description of its minute appearances, it would appear that the osteoid cancer of Paget is composed mainly of dense fibrous tissue, with which are sometimes mingled, as if imbedded in the interstices of the fibres, cancer cells "not differing from those of common scirrhus cancers in anything, unless it be that they are smaller and less plump." On the addition of acetic acid "the fibrous tissue becomes clearer, and we find abundant nuclei imbedded in it," which are generally oval, and from $\frac{1}{2000}$ to $\frac{1}{3000}$ of an inch in length. From this account I am disposed to regard such a structure as being identical with the fibronucleated tissue of Bennett, which Paget² himself believes to be nearly related to that of the recurring fibroid tumours, and is included by Virchow in his group of spindle-celled sarcoma. That the fibrous tissue should present such peculiar appearances as those shown at *c*, Fig. 126,³ may readily be explained by the fact, as I shall show presently, that the most of these tumours are really examples of fibrous sarcomas, the intercellular fibrous element of which is sclerosed, or thickened and condensed, while the cells have disappeared through fatty changes and atrophy, or have possibly been converted into bone corpuscles. At *b*,⁴ the fibrous tissue forms a delicate reticulum which is indistinguishable from that of the lymphadenoid variety of round-celled sarcoma, and, I believe, that the tumour from which the drawing was made was, in reality, an example of that form of sarcomatous tissue. In none of these illustrations, nor in the text, is there anything pointing to an alveolar arrangement of the stroma, with included epithelial cells, so that the conclusion is inevitable that the distinguished observer has described osteoid sarcoma under the head of osteoid cancer.

In several of the cases that I have collected with the view of writing the general pathology of osteoid sarcoma, the minute structure agreed with the description of Paget; but the majority consisted of spindle-celled tissue.⁴ Thus, of 21 instances, 14 were of that nature, while 5 were round-celled, and 2 were mixed growths, or composed of spindle and round elements in about equal proportions, thereby confirming the statements of Billroth,⁵ Förster,⁶ Senftleben,⁷ Virchow,⁸ and Carrera,⁹ that they are

¹ Trans. Path. Soc., London, vol. vi. p. 317.

² Op. cit. p. 605.

³ Op. cit. p. 762.

⁴ I have not included in this account cases of osteoid chondroma, in which the tissue corresponds to that of membranous or osteoid cartilage; and I have omitted the cases of Gerlach, in which the minute structure resembled that of carcinoma, although I have every reason to believe that the tumours were osteoid alveolar sarcomas.

⁵ Virchow's Archiv, vol. xviii. p. 87.

⁶ Hdbch. der Path. Anat., 2d ed., vol. i. p. 387.

⁷ Langenbeck's Archiv, vol. i. p. 155.

⁸ Op. cit. p. 298.

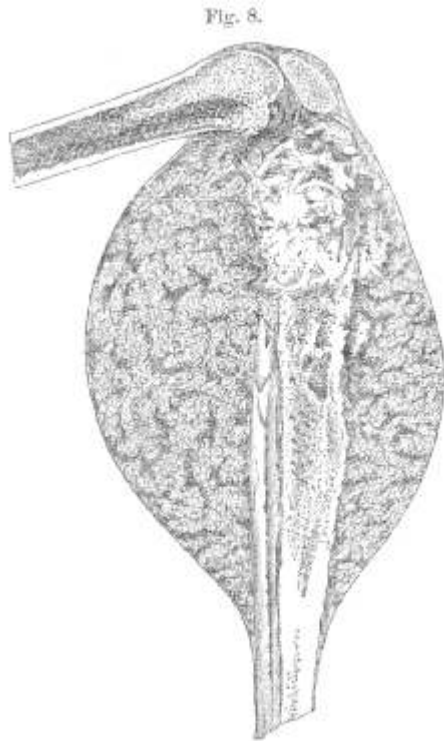
⁹ Tumeurs Fibroplastiques des Os, Thèse de Paris, 1865, p. 52.

mainly calcified or ossified spindle-celled tumours, and not, as is curiously stated by Cornil and Ranvier,¹ for the most part, myeloid growths.

On section, osteoid sarcomas generally exhibit an interior calcified or ossified structure, surrounded and pervaded by unossified tissue, which may be dense, firm, and glistening, or soft and medullary, like the substance of the brain, or even semifluid and gelatinous. The osseous or cretified material usually radiates from the bone to the periphery of the tumour, in the form of fragile, delicate spicules, tufts, or plates, which are closely aggregated at their bases, and pursue a parallel course perpendicular to the surface of the affected bone, or diverge towards the circumference.

In other specimens, as in No. 317 of the Mütter Museum, the implicated femur looks as if it had been the seat of inflammatory irritation, being much roughened and elevated into thick and short osteophytic vegetations, which are inseparably connected with the compact tissue of the femur, and represent a true hyperplastic process. Again, the ossified portion of the growth may form a huge mass of what looks like spongy bone, as in No. 103, of the humerus. In other examples, the appearances are those of dense ivory-like bone, or, as is illustrated by Nos. 198 of the humerus and 1609 of the tibia, the latter of which is reproduced in Fig. 8, the tumour is principally composed of a collection of large tubers or nodules, which are as fragile as dried mortar.

In the majority of instances, the intercellular substance is simply calcified or petrified, so that the cellular elements are clearly displayed on the addition of chlorohydric acid. In others, or in parts of the same specimen, the tumour is pervaded by imperfect bone. Hence, Grohe² divides osteoid sarcomas into spongoid and ossifying sarcomas; the former being characterized by calcareous infiltration, and the latter by the formation of



¹ Op. cit., vol. ii. p. 375.

² Bardleben's Lehrbuch der Chir., etc., 6th ed., vol. i. p. 580.

new bone. Such a distinction, however, is entirely superfluous, since calcification is the initial stage of ossification, and the clinical features and prognosis of both forms are identical, although Cornil and Ranvier¹ erroneously state that ossifying sarcomas are benign affections, while calcifying sarcomas are to be regarded with suspicion.

As happens in the other varieties of periosteal sarcomas, the bone upon or around which the tumour grows is usually not involved in the disease, but in about 40 per cent. of all cases the subjacent medullary canal or spongy substance of the epiphysis is the seat of similar deposits. In some instances the internal and external tumours communicate by an opening in the compact tissue of the bone; but, as a rule, the latter remains entire, although it is sometimes the seat of infiltration, when infection of the marrow seems to have taken place along the Haversian system. These changes are well shown in Fig. 8, in which the head of the tibia and the upper half of the shaft are invaded by the morbid material which originated in the periosteum. From a practical point of view, it should be remembered that the medulla may be affected not only at the immediate seat of the tumour, but at some distance beyond. Thus, in a case of Stanley,² in which amputation was practised in the upper third of the thigh for an osteoid sarcoma of its lower third, on death, a circumscribed nodule was discovered in the bone of the stump; and in a still more remarkable example,³ recorded by that surgeon, of a tumour of the upper portion of the tibia, the entire medullary canal of the femur was occupied by deposits of ivory-like bone.

Osteoid sarcomas are liable to the same degenerations and combinations as are the other varieties of the group. Of these, the most common are the cartilaginous and myxomatous; the former occurring in 20 per cent. and the latter in 12 per cent. of all cases.

They are not very vascular; but in 14 per cent. of all instances,⁴ and especially when they have undergone fatty and myxomatous degeneration, they are the seat of more or less extensive extravasations of blood. Of these, the most striking example is that recorded by Weil, and it is very similar to his case of central hemorrhagic round-celled sarcoma of the humerus, which I have already quoted. The tumour, which was only of six weeks' duration, was converted into a cyst, as large as the two fists, and filled with blood. On attempting to preserve the limb by excision of the sac, twenty-five large arteries and veins required ligation, and the femoral artery had to be taken up before the hemorrhage ceased. On death from consecutive amputation, sixteen weeks after the first appearance of

¹ Op. cit., vol. i. p. 143.

² Op. cit. p. 169.

³ Op. cit. p. 165, and Illustrations, plate 19.

⁴ Cases of Weil, *Prager Vierteljahrsschrift*, vol. iv., 1877, p. 5; Volkmann, *op. cit.* p. 19; De Morgan, *Trans. Path. Soc., London*, vol. xxi. p. 337; Arnott, *ibid.*, vol. xxii. p. 214; and Wagstaffe, *ibid.*, vol. xxiv. p. 183.

the tumour, metastatic deposits were found in the lungs, pleura, liver, kidneys, sternum, and parietal bone. In the case of Wagstaffe, which was also undergoing myxomatous degeneration, large vessels could be traced in close contact with the walls of a huge cyst which occupied the superficial portion of the tumour. The progress of the disease was not, however, so rapid as in the former instance, as the total duration of life was ten months. The lungs, pleura, liver, and spleen were the seat of secondary growths.

In an instance described by Stanley,¹ the femoral artery was tied on account of a pulsating osteoid sarcoma of the lower end of the femur, with the effect of arresting the pulsation and temporarily impeding its growth; and Sedgwick² has recorded a remarkable example of pulsation and bruit seated in a bony metastatic tumour of the clavicle, which appeared to be independent of the subclavian artery. The primary growth was "full of large vessels."

Spontaneous inflammation, ulceration, and fungous protrusion occur in only about 11 per cent. of all cases, these accidents having been observed by Howship,³ Stanley,⁴ Lebert,⁵ and Hillier.⁶ In the case of Howship the fungus was the seat of repeated and exhausting hemorrhages. Ulceration and gangrene are, however, extremely liable to follow surgical interference as for example, the application of the actual cautery, under the supposition that the disease is white swelling, of which occurrence an instance is recorded by Volkmann,⁷ or an exploratory incision or puncture, of which cases are reported by Wilks,⁸ Virchow,⁹ and Volkmann.¹⁰

Peripheral osteoid sarcomas are most common on the bones of the lower extremity, and evince a predilection for their expanded articular ends. Thus of 45 cases of which I have examined specimens or collected histories, the femur was affected in 24, the tibia in 13, the fibula in 2, the humerus in 5, and the radius and ulna in 1.

Of 39 cases in which the sex is noted, 24 occurred in men and 15 in women, 47 per cent. of whom traced the disease to traumatism, and 6 per cent. to rheumatism.

Their greatest frequency is before the thirtieth year. The youngest patient was twelve years of age, and the oldest fifty-five years at the time of the first manifestation of the tumour, the average age being 22.6 years. These facts are set forth in the following table:—

¹ Op. cit. p. 167.

² Brit. and For. Med.-Chir. Rev., vol. xvi. p. 205.

³ Pract. Obs. in Surgery, etc., p. 443.

⁴ Traité d'Anat. Path., vol. ii. p. 592.

⁵ Guy's Hosp. Rep., ser. 3, vol. iii. p. 155, case i.

⁶ Op. cit. vol. ii. p. 304.

⁷ Op. cit. p. 167.

⁸ Ante.

⁹ Op. cit. p. 16.

¹⁰ Op. cit. p. 19.

Age.	No. of Case
10 to 20	18
20 " 30	15
30 " 40	3
40 " 50	2
50 " 60	1
	39

Their growth is progressive and continuous, and usually so rapid that they may attain the volume of a double fist in six weeks¹, or a circumference of twenty-five inches in six months,² particularly if they be the seat of interstitial hemorrhage or mucoid changes. Independently of these alterations, they may be as large as a cocoanut in four months,³ or have a diameter of eight inches in fourteen weeks,⁴ or increase at the rate of half an inch a week.⁵

During their further progress, osteoid sarcomas evince a disposition to extend beyond their limiting capsules and invade the surrounding structures. As I have already pointed out, the medulla of the affected bone is involved in 40 per cent. of all instances. The soft tissues are implicated in 30 per cent., the skin, however, as a rule, preserving its mobility and natural colour, being red, thinned, or ulcerated in only 20 per cent. of all cases. In one case only was a contiguous vein occluded by the morbid material, thrombosis of the axillary vein having occurred in connection with a tumour of the upper end of the humerus.⁶ In 6 per cent of the cases the growth made its way into the adjacent joint, but the cartilages remained intact.⁷

Primary implication of the associated lymphatic glands is recorded in only seven instances, or in 21.87 per cent. of all cases. In four the enlargement was due to irritation; in two the glands were converted into osteoid tissue,⁸ while in the remaining one the structure was not noted.

Not only are osteoid sarcomas locally infectious, but they are next to the pure periosteal spindle-celled the most malignant of all the neoplasms of the osseous system, since 65.62 per cent. of all cases die, sooner or later, with metastatic deposits, no matter whether they have been subjected to operation or not. Thus of 33 instances, of which the terminations are recorded, in 7 the affection pursued a natural course, and of these, in one the viscera was not examined, while in four the internal organs were affected. Of 26 operations, 1 was fatal from septicæmia without metastatic deposits; 6 lived, and 19 subsequently died. In 17 of these the disease was generalized, and in 2 it recurred locally several times.

¹ Weil, ante.

² Wagstaffe, ante.

³ Jackson, Trans. Path. Soc., London, vol. xvii. p. 209.

⁴ Küster, Langenbeck's Archiv, vol. xii. p. 630.

⁵ Sedgwick, ante.

⁶ Virchow, op. cit. p. 304.

⁷ Holmes and Volkmann, ante.

⁸ Stanley, op. cit. p. 168, and Paget, op. cit. p. 761.

The duration of life in the 7 cases¹ which ended in death without surgical intervention averaged sixteen months. Two died in the first year; three in the second year; and in two the patients lived only a "short time."

Of the 6² that recovered from amputation, and remained well without local or general return, the average duration of life was 58 months, the shortest period having been seven weeks, and the longest twenty years.

Of the remaining 20 operations³ all of which were amputations, except one instance of ligation of the femoral artery, and one of excision of the upper half of the fibula, strange to say, only one died. The rest recovered and lived for periods which varied from four months to twenty-five years. In 17 of these, metastatic deposits were discovered, and in 7 there was local recurrence at the site of the operation, while 2 died of local recurrence, without any indications of visceral complications. In 13 of these cases, of which I have accurate accounts, the total duration of life averaged 92.7 months, or seven years and eight months. Thus, four died in the first year, three in the second year, one in the fourth year, and one in the sixth year, while one lived for seven and a half years, one for eighteen years, one for twenty-four years; and one for twenty-five years.

In the majority of instances the secondary deposits were also calcified or ossified. Their seat was in the

Lungs	in 16 cases.	Skin	in 1 case.
Lymphatic glands	" 7 "	Liver	" 1 "
Bones	" 7 "	Omentum	" 1 "
Diaphragm	" 3 "	Subcutaneous tissue	" 1 "
Pleura	" 3 "	Spleen	" 1 "
Pericardium	" 2 "	Superior cava	" 1 "
Kidney	" 2 "	Perichondrium	" 1 "
Brain	" 1 case.		

Not only are the periosteal osteoid sarcomas next to the other peripheral varieties more destructive to life than other tumours of bones, but they are more malignant than the central osteoid sarcomas. Thus of 12

¹ Cases of Wilks, op. cit.; case iv. p. 157; Hillier, ante; Volkmann, op. cit. pp. 14 and 19; Küster, ante; Howship, ante; and Virchow, op. cit. p. 304.

² Cases of Norton, Trans. Path. Soc., London, vol. xxiii. p. 179; Nicaise, Bull. et Mém. de la Soc. de Chirurgie, vol. ii. 1876, p. 212; Wilks, op. cit., case of John T., p. 158; Jackson, Trans. Path. Soc., London, vol. xvii. p. 209; Grohe, Bardleben's Lehrbuch, 6th ed., vol. i. p. 582, and Berend, Deutsche Klinik, 1860, pp. 208 and 217, and Virchow, op. cit., vol. ii. p. 313.

³ Cases of Weil, ante; Danzel, Langenbeck's Archiv, vol. xv. p. 72; Verneuil, Bull. de la Soc. Anat., vol. xxix. p. 262; Wagstaffe, ante; Birkett, Guy's Hosp. Rep., ser. 3, vol. iii. p. 336; Paget, op. cit. p. 767; Wilks, op. cit. pp. 155-158; Sedgwick, ante; Stanley, op. cit. pp. 165-168; Senftleben, Langenbeck's Archiv, vol. i. p. 167; Arnott, Trans. Path. Soc., London, vol. xxii. p. 214; Baum, Virchow's Archiv, vol. xviii. p. 86; Bennett, Cancerous and Cancroid Growths, p. 103; and Holmes, ante.

examples of ossifying myelogenic giant, spindle, and round-celled sarcomas 50 per cent. gave rise to metastatic deposits, while 65.62 per cent., of the peripheral form were attended with or followed by systemic infection.

Although generalization may ensue in so short a period as four months, as happened in the case of Weil, it may be deferred for many years, or even not occur at all. Thus in a case of Stanley's,¹ the disease had existed for eighteen years, but on death, two months after removal of the limb, metastatic tumours were found in the pleura, lungs, pericardium, and superior vena cava. In the case of Mr. Plympton, recorded by Paget,²

"a swelling appeared in the upper arm of a woman thirty-two years old. After ten years' growth, when it had increased to seven pounds weight, it was removed by Mr. Hewson. It had the characters of osteoid cancer. The patient completely recovered from the operation; but, about a year after it, a new tumour appeared about the humerus, and at the end of four years had acquired a huge size, and a weight of fifteen and a half pounds. For this, which proved to be a similar osteoid growth, the arm was amputated at the shoulder-joint. She recovered from this operation also; but the disease returned in the scapula, and, in about ten years after the amputation, and twenty-four years from the beginning of the disease, she died."

Not less remarkable is the case described by Holmes:—³

"The thigh was originally amputated on account of a hard and heavy dry osseous substance surrounding the ends of the femur and tibia, projecting into the knee-joint, extending far up the thigh, and surrounding the popliteal artery, vein, and nerve, so as to cause œdema and severe pain. The patient remained well for five years; then another osteoid tumour formed on the stump of the femur, accompanied with severe pain. Amputation was performed higher up. The tumour appeared to grow, not from the bone itself so much as from the periosteum, and inclosed the femoral artery. There was again an interval of health for two years; then a fresh tumour formed about the stump, continued to increase upwards out of reach of operation, and finally killed him from inflammation and sloughing of its soft coverings, twenty-five years after the first appearance of the disease. He had been in good general health during the whole time."

Peripheral osteoid sarcomas begin with pain in 62.5 per cent., with a tumour in 33.33 per cent., and with simultaneous pain and swelling in 4.16 per cent. of all cases. Suffering, which is aggravated by exercise, and liable to severe exacerbations, is so constantly present, that its entire absence is noted in only one instance. In the commencement it is not great, but as the tumour grows, it becomes intense, particularly at night, affects the general health, and is the cause of death in the majority of instances.

Like the uncalcified or unossified periosteal sarcomas, the osteoid variety gives rise to pyriform, or long-oval, oblong, or fusiform tumours, which are smooth and even on their surface, except when they have burst through their capsules, when they are nodulated, bosselated, or lobed. Their consistence is usually firm and dense, although it may be firm at some points and soft and even fluctuating at others. The skin, when the mass is not interfered with, is altered in only 20 per cent. of all cases, being tense

¹ Ante, p. 165.

² Ante.

³ Ante.

and discolored, or ulcerated in about an equal number of instances. Now and then the bony spicules may be seen at the bottom of the ulcer. The subcutaneous veins are enlarged in 31 per cent.; the lymphatic glands are involved in 21 per cent.; the temperature is elevated in 6 per cent.; pulsation is present in rather less than 3 per cent.; and fracture from slight causes occurs in 3 per cent of all cases.

From the above considerations it follows that a hard, rapidly-growing, painful, and non-pulsating tumour, developed at about the twenty-second year, and unaccompanied by fracture or discoloration of the skin, but attended, possibly, by enlargement of the superficial veins and lymphatic involvement, may be classed among the osteoid sarcomas. In the event of an associated gland being densely hard, or of the existence of bony matter in the bottom of an ulcer, its nature is unmistakable.

The Differential Diagnosis of Periosteal Sarcomas.—For purposes of comparison I have drawn up the following table of the clinical features of the periosteal sarcomas, from which it will be seen that there are essential points of distinction. The longer duration of life in the osteoid variety is accounted for by the cases in which the patients lived many years after operation. Were these deducted there would be little difference in the prolongation of life in the three divisions.

	Round-celled.	Spindle-celled.	Osteoid.
Relative frequency	19.40 p. c.	13.43 p. c.	67.16 p. c.
Occur before 30th year	63.63 "	66.66 "	91.66 "
Seated around shaft of the long bones	69 "	55. "	39 "
Ushered in by pain	55 "	85.71 "	62 "
" " swelling	44 "	14.29 "	33 "
" " " and pain	0 "	0 "	4 "
Pain throughout the disease	66 "	100 "	98 "
Skin variously altered	51 "	22.22 "	20 "
Subcutaneous veins enlarged	41 "	33.33 "	31 "
Infection of adjacent tissues	50 "	44 "	40 "
Lymphatic glands tumefied or involved	38.46 "	11 "	21 "
Metastatic deposits	66.66 "	100 "	65.62 "
Local recurrence	50 "	60 "	41 "
Pulsation	0 "	0 "	3 "
Fracture, spontaneous, or from slight causes	7 "	11 "	3 "
Joints invaded	15.38 "	0 "	6 "
Duration of life without operation	?	?	16 mos.
" " with operation	18 mos.	20 mos.	92.7 "
" " " " and still alive	34 "	0 "	58 "

The distinction between the periosteal chondromas and periosteal sarcomas is based upon the following features: The former are relatively far more common, as they constitute 86 per cent. of all cartilaginous tumours of the long bones, while only 41 per cent. of sarcomas are of peripheral origin. They are far less painful, of slower growth, of denser consistence, and are, as a rule, nodulated. They are usually met with in females; do

not occur so early in life, but are met with at a more advanced age than are the sarcomas; and appear, on an average, four years sooner than the latter. The subcutaneous veins are not so liable to enlargement; the overlying integuments evince little disposition to inflame or ulcerate; they do not pulsate, fungate, invade the joints, or contaminate the glands, and they occasion secondary deposits only one-twentieth as often. In about one-third of all cases, moreover, other portions of the skeleton are simultaneously affected, while multiplicity is not witnessed in the sarcomas.

These differences in their principal signs may be the better appreciated by a reference to the following table:—

PERIOSTEAL CHONDROMA. ¹	PERIOSTEAL SARCOMA. ²
1. Constitutes 86 per cent. of all cartilaginous tumours.	1. Constitutes 41 per cent. of all sarcomas.
2. Appears between the tenth and sixty-first years, or, on an average, at the age of twenty-six.	2. Appears between the seventh and fifty-fifth years, or, on an average, at the twenty-second year.
3. 63 per cent. of all cases occur in females.	3. 38 per cent. of all cases occur in females.
4. Grows comparatively slowly.	4. Rate of growth is more rapid.
5. Usually begins insidiously, but pain is present throughout in 47 per cent. of all cases.	5. Usually ushered in by pain, and pain throughout in 94 per cent. of all cases.
6. The subcutaneous veins are dilated in 21 per cent. of all cases.	6. The subcutaneous veins are dilated in 30 per cent. of all cases.
7. The skin is variously altered in 10 per cent. of all cases.	7. The skin is altered in 25 per cent. of all cases.
8. The lymphatic glands are free from enlargement.	8. The lymphatic glands are enlarged in 22 per cent. of all cases.
9. Spontaneous fracture, or fracture from slight causes, is met with in 5 per cent. of all cases.	9. Fracture occurs in 5 per cent. of all cases.
10. Metastatic deposits occur in 3.17 per cent. of all cases.	10. Metastatic deposits occur in 69.04 per cent. of all cases
11. Never pulsates.	11. Pulsation met with in 1.8 per cent. of all cases.
12. Does not invade the joints.	12. Joints involved in 7 per cent. of all cases.
13. Is multiple in 32.8 per cent. of all cases.	13. Is never multiple.

In regard to the distinction between periosteal sarcoma and white swelling of the joints, I have nothing to add to what I have already stated in my remarks upon sarcoma in general.

When it is remembered that not only the soft parts and the corresponding portion of the medulla of the bone around which the tumour is seated

¹ Based upon an examination of sixty-three cases.

² Based upon an examination of fifty-six cases.

are liable to be invaded by the morbid product, but that nodules of sarcomatous tissue may exist in the medullary canal at some distance from the original growth, the line of practice to be followed in the periosteal sarcomas is to amputate as far as possible from the seat of the disease as may be consistent with the patient's safety. Thus, for example, the limb should be removed at the knee for a tumour occupying the lower end of the tibia or fibula; the thigh should be amputated close to the lesser trochanter for a growth involving the lower third of the femur; and if the soft tissues or medulla are found to be infiltrated, disarticulation at the hip should at once be resorted to. When the neoplasm is seated near the trunk, the case had best be left to pursue its natural course, since experience shows that local recurrence, as after amputation at the shoulder, nearly always, if not constantly, ensues.

ARTICLE III.

FOUR CASES OF OVARIAN TUMOUR AND ONE OF FIBRO-CYSTIC TUMOUR OF THE WOMB, OPERATED ON UNDER THE SPRAY. By WILLIAM GOODELL, M.D., Professor of Clinical Gynæcology in the University of Pennsylvania.

No operations on the human body offer so much of interest to the profession as those involving the cavity of the peritoneum. The vulnerability of this membrane, the important organs which it contains, and the fatal character of the diseases for the relief of which its sanctity is invaded, make the record of every case imperative.

Again, while antiseptic ovariectomy has been resorted to with wonderful success by Wells, Keith, Thornton, Bantock, Olshausen, Shroëder and by other European ovariectomists, it has been strangely neglected by our own. Isolated cases are the only ones which appear in our journals, and I shall therefore offer no apology for giving my own experience, limited though it be, with antiseptic laparotomy.

CASE I.—J. M., aged 53, and single, reached the climacteric in 1872. In March, 1877, a tumour appeared in the uterine region, which grew rapidly. It gave her no inconvenience except from its bulk. I saw her first early in September, 1878, and found her much emaciated and her abdomen enormously distended by an ovarian cyst. She was otherwise in very fair health, and had come eight miles to see me. The womb lay to the left and behind the tumour. It measured 3.5 inches, but was movable. The operation was performed at 11 A. M., Oct. 27th, in a small private room of the hospital of the University of Pennsylvania, and I was assisted by Drs. J. Ashlurst, B. F. Baer, W. L. Taylor, and Richard H. Harte. There were also present Drs. A. H. Smith and W. S. Forbes, and six students.

There being many parietal adhesions the incision was carried up two